DOCUMENT RESUME

ED 133 709 CS 003 150

AUTHOR DeRose, Thomas
TITLE The Effects of Verbally and Pictorially Induced and Imposed Strategies on Children's Memory for Text. Technical Report No. 394.
INSTITUTION Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Aug 76
CONTRACT NE-C-00-3-0065
NOTE 178p.; For related document, see CS 003 149

EDRS PRICE MF-$0.83 HC-$10.03 Plus Postage.
DESCRIPTORS Grade 5; Intermediate Grades; *Mediation Theory; *Reading Comprehension; *Reading Processes; *Reading Research; *Success Factors

ABSTRACT

The effects of subject-generated and experimenter-provided verbal and pictorial elaboration on memory of prose were investigated in a sample of 192 fifth-grade pupils. Based on scores obtained from standardized reading tests, pupils were divided into those above, and those below, grade level. Each child read a social studies textbook passage under one experimental condition and answered 14 short-answer questions about it. Results indicated that for questions based on elaborated text, the only significant effect was for experimenter-provided pictures; for questions based on unelaborated parts of the text, there were no significant effects. Directions for future research were discussed in terms of employing different types of passages, more disparate groups of subjects, different forms of elaboration, and other dimensions related to individual differences. (Author/AA)

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Technical Report No. 394

THE EFFECTS OF VERBALLY AND PICTORIALLY INDUCED AND IMPOSED STRATEGIES ON CHILDREN'S MEMORY FOR TEXT

by

Thomas DeRose

Report from the Project on
Conditions of School Learning and
Instructional Strategies

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August 1976

CS003 150

This Technical Report is a doctoral dissertation reporting research supported by the Wisconsin Research and Development Center for Cognitive Learning. Since it has been approved by a University Examining Committee, it has not been reviewed by the Center. It is published by the Center as a record of some of the Center's activities and as a service to the student. The bound original is in the University of Wisconsin Memorial Library.

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the National Institute of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education and no official endorsement by that agency should be inferred.

Center Contract No. NE-C-00-3-0065

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The Wisconsin R&D Center is supported with funds from the National Institute of Education; the Bureau of Education for the Handicapped, U.S. Office of Education; and the University of Wisconsin.

ACKNOWLEDGMENTS

Although the authorship for this document is officially acredited solely to me, I must emphasize the fact that a great deal of thought, time, and energy have been contributed by the members of my committee. Furthermore, their individual contributions extend far behond this manuscript to my graduate career in general. In fact, my decision to select these individuals for inclusion in my dissertation committee was based on the fact that they have been most responsible for my intellectual growth during my stay at the University of Wisconsin.

Working with Joel Levin for these past four years has been my greatest fortune. Not only has he helped me develop logic and research skills, but he has instilled in me his intense interest to convey these skills to students. Certainly this is an accomplishment for him--not only to "reach" those students who have close personal contact with him, but to "reach" the students of his students. I know he will always have an effect on me.

My encounters with the other committee members have been brief, but invaluable. Robert Davidson has served on all of my committees, and in that capacity has never ceased to challenge me. Through this interaction, my thinking and writing have become increasingly clearer and sharper. Philip Morse, though his critical perception of the classroom situation, has increased

my teaching skills. M. Vere DeVault was the first person at Madison to encourage me to develop my writing skills. Steven Yussen has, through classroom meetings and informal research discussion, provided me with a great deal of exciting knowledge.

I cannot expect to adequately express my appreciation to these five individuals. As they have encouraged me to grow, I hope that I can encourage others. Above all else, I value the friendship that has developed between each of these individuals and myself.

My appreciation is also extended to Marcia Ledford who not only typed, but also proofed and edited the final draft of this manuscript.

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ABSTRACT

The present study was an attempt to extend the results of research in which subject-generated and experimenter-provided verbal and pictorial elaboration has been shown to facilitate paired-associate learning, as well as investigations of the differential facilitation due to reader differences of elaboration strategies on memory for text.

Fifth graders read a social studies textbook passage under one of four experimental conditions (subject-generated or experimenter-provided, verbal or pictorial, elaboration) or control. After data collection, subjects were divided into above or below average ability readers (based on standardized reading comprehension tests). The prediction was that below average readers would benefit most from the elaborative strategies--especially imposed pictures, where reading demands are reduced--and that above average readers might or might not benefit from the experimental treatments.

For the E-Picture condition, a main point of each paragraph was illustrated by a line drawing. For the E-Verbal condition, sentences were constructed that corresponded to each of the

illustrations. Each passage was presented with one paragraph on the left side of a page along with either its corresponding illustration or verbal statement to the right. In the two conditions in which subjects were to provide their own elaboration (S-Picture and S-Verbal), either the word PICTURE or SENTENCE asspeared on the right side of the page. Fourteen short-answer "Wh" questions were generated for the passage: seven corresponding to elaborated text (that is, corresponding to text that was explicitly illustrated), seven corresponding to the remainder of the text.

The words SENTENCE or PICTURE were cues to the subjects respectively either to think of in their own words what the paragraph was about, or to get a picture in their mind corresponding to what the paragraph was about. All subjects were told that they would be tested after reading the paragraph and that the elaboration would help them remember the story. Subjects were tested individually.

Based on scores obtained from standardized tests, subjects were divided into two groups--above and below grade level.

For responses to both sets of questions (those pertaining to text which was elaborated, and those pertaining to text which was not elaborated), planned comparisons were performed to determine facilitation due to treatments and differential effects related to ability level.

Analysis of Elaborated Text Questions: For the main effect

comparisons between treatments and control, there was only one comparison which was significant--E-Pictures compared to the Control. This finding has been consistently supported by research; not only where passages have been specially constructed for the task, but also when passages were taken from textbooks and children's stories.

In addition to the interest in the effects due to treatments, it was also expected that there would be an interaction between treatment and ability: The low ability group would benefit more from provided illustrations than would the high ability group. This was not found to be the case. In fact, both groups benefited from illustrations by about the same amount compared to the Control.

Analysis of Unelaborated Text Questions: Of the planned comparisons for these questions, none were significant. There was no facilitation for text to which these questions referred. Possible reasons for failure to obtain facilitation for unelaborated text were suggested: Such facilitation does not occur with the particular strategies used in the present investigation, and/or the difficulty of the passage prevented this finding from being observed.

Directions for future research were discussed in terms of employing different types of passages, more disparate groups of subjects, different forms of elaboration, and other individual differences dimensions.

Chapter I

INTRODUCTION

Memory for what one reads is facilitated when the contents of the material to be read are well organized. This organization may be inherent in the text, it may be supplied by adjunct materials, or the reader may supply the organization himself. Successful readers are assumed to be capable of spontaneously bringing such organizational skills to bear on the text while less successful readers can improve their memory by following the instructions of a teacher or an experimenter; they are presumably not skilled in spontaneous generation of appropriate organizational strategies (Levin, 1972a). Improving memory may consist, therefore, in either providing materials which are organized in ways that emphasize important ideas contained in the text, or instructing the reader to adopt some organizational strategy.

Just what are these organizational skills and how can they be applied to the typical reading situation? As far back as 1932, Bartlett spoke of "organizational schemas" which serve to aid memory. Exactly what these schemas may be has been the subject of a growing body of literature. Various organizational techniques have been tried and many of them have been refined to a point where increasing control over the relevant variables has been achieved. For example, placement of questions throughout the text which require the reader

to furnish answers contained in the text have been found to improve memory considerably (Rothkopf, 1970), while instructions to form images corresponding to sentences in a passage also greatly improve memory (Levin, in press).

The idea of improving memory (for unconnected materials) through elaboration has been discussed at length by Rohwer (e.g., 1971) who showed that elaborating the material to be learned (by either modifying the materials, training subjects to elaborate the materials, or both) resulted in improved memory. Elaboration, therefore, includes the manipulation of the properties of learning materials that facilitate memory, and the training of mental activities that make for efficient learning. In the area of memory for text, these organizational techniques may be classified into three types, namely those that: (a) supply some form of advance organization presented before the actual text is read; (b) provide organizational strategies to be applied during reading; or (c) manipulate the text itself, rendering it more comprehensible and memorable.[1]

---

[1] The present discussion has been confined to only those techniques which affect storage of the material being learned; that is, ways in which the content of the text is presented to the reader, and ways in which the reader organizes the content of the text in memory. An interest in retrieval aspects (i.e., experimenter-provided retrieval cues or strategies which the reader may adopt to retrieve material which has already been committed to memory) will not be considered in the present paper.

The first of these, advance organization (Ausubel, 1963), provides the reader with some information about the main topic of a passage before the passage is read. By providing this information, it is assumed that the reader will be better able to comprehend the meaning of the passage. This belief is based on the constructionist view (Barclay, 1973) that meaningful material is processed in relation to information already in the knowledge structure of the reader. When the reader encounters the passage, he has a concept or a theme on which to connect the main ideas of the passage. Techniques that provide this advance organization include prefamiliarization cues--providing a theme, topic, or title for the passage (e.g., Bransford & Johnson, 1971); Ausubelian advance organizers--supplying higher level concepts on which the passage is based (e.g., Romberg & Wilson, 1973); and analogy and metaphor--presenting a concrete or familiar example to which an abstract or less familiar concept may be related (Davidson, in press).

The second type of elaboration technique includes organizational strategies performed during the reading of a passage. The use of such techniques is intended to improve memory by controlling the processing activities of the reader (Rothkopf, 1970). These organizational strategies include: responding to questions pertaining to the contents of the text (e.g., Rothkopf & Bisbicos, 1967); drawing pictures or writing verbal summaries corresponding to the text (e.g., Snowman & Cunningham, 1975);

looking at pictures that describe the contents of the text (e.g., Rohwer & Matz, 1975); and utilizing covert imagery and/or verbal strategies corresponding to the content of the text (e.g., Anderson & Kulhavy, 1972). The use of these strategies is also based on the constructionist model in that they require the reader to comprehend the meaning of the passage in relation to the associated adjunct activities.

The third type of elaboration technique consists of manipulation of the text material itself. Such manipulations consist of modifying the comprehensibility of the material [for example, by making it more or less concrete (e.g., Andrasik, Liebert, & Koler, 1974), or altering the syntactical structure (Rohwer, 1966)].

Elaboration through the manipulation of materials, and the training of learners has been referred to respectively as "imposed" and "induced" strategies by Levin (1972b). Imposed strategies include manipulation of the properties of the learning materials by the experimenter and may require some adjunct material in addition to the passage. A strategy is induced in learners, in contrast, prior to learning, by instructions supplied by the experimenter. With an induced strategy, the learner is not provided with different representations of particular items (as with an imposed strategy) but rather with instructions to generate his own verbal or pictorial elaboration which improves learning. The important distinction to keep in mind here is the distinction

between subject-generated as opposed to experimenter-provided learning strategies (Levin, 1972b). Examples of imposed learning strategies in prose-learning contexts include the manipulation of concreteness/abstractness of the printed text, and supplying adjunct pictures corresponding to the text. Examples of induced learning strategies include instructing the reader to generate images or verbal summaries while reading the text material. The present investigation will be concerned with both imposed strategies (adjunct pictures and verbal statements) and induced strategies (instructions to image or generate verbal statements).

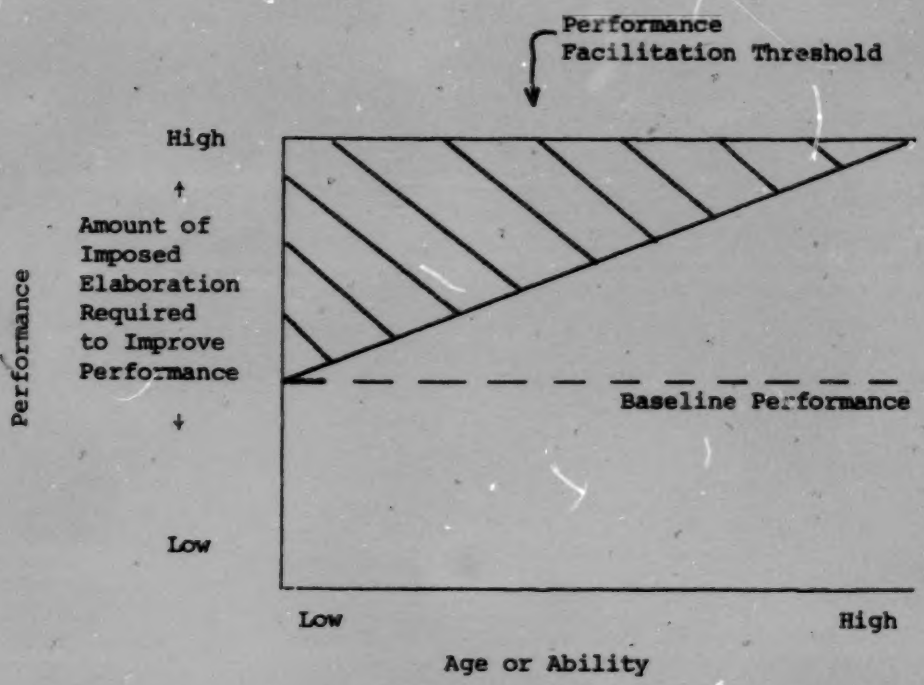
Not all elaboration strategies fit nicely into these dichotomous groupings, however. For instance, subject-generated drawings corresponding to a passage are induced in that the reader generates responses which facilitate retention of the text, while at the same time, the product of the subject's response--the picture--imposes on the reader a concrete pictorial representation of the text. While not experimenter-provided, the pictorial representation is a different external representation of the passage.

It may, in fact, be profitable to hypothesize that different elaboration techniques fall somewhere along a continuum as in Figure 1. At young ages or low levels of ability, it might be expected that greater amounts of imposed elaboration are necessary to improve learning performance. As age or ability increases, however, the amount of imposed elaboration needed decreases. This shift in strategies continues to a point where subjects are

able to benefit even from pure induced elaboration (Guttmann, 1976). For instance, in a prose context experimenter-provided pictures corresponding to the text contents would be an example of a maximally imposed elaboration, instructions to image would be a maximally induced elaboration, and instructions to draw would fall somewhere in between these two extremes.

FIGURE 1

AMOUNT OF IMPOSED ELABORATION NECESSARY TO IMPROVE LEARNING PERFORMANCE AS AGE OR ABILITY INCREASES



It should be noted here that Rohwer's (1973) discussion of prompts with reference to elaboration in paired-associate learning and the model underlying the continuum depicted in Figure 1, are

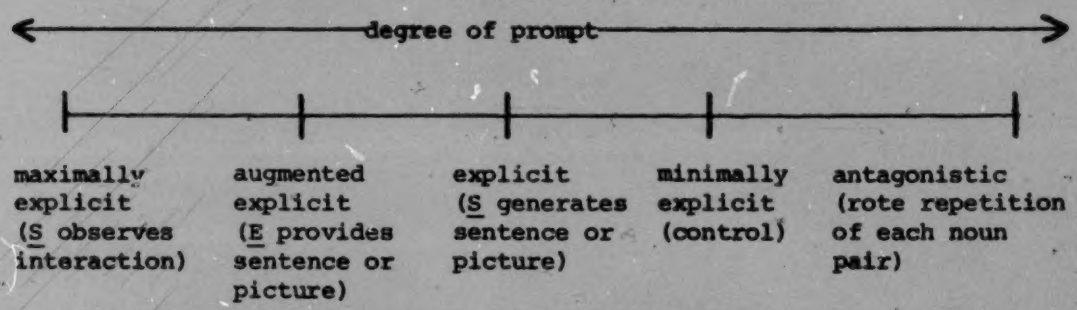
both based on the assumption that the amount of imposed elaboration (prompt in Rohwer's terminology) necessary to achieve facilitation decreased with age or ability. Of course, it must be pointed out that the concept of elaboration as used by the present author differs considerably from the way it is used by Rohwer. Specifically, in the present investigation, elaboration refers to strategies which are either used or generated by the reader when reading a passage. Rohwer, however, views elaboration as a process within the organism which is activated by external "prompts." According to this extreme view, the process per se does not change as a function of age or ability. Rather, the probability of activating it (as a result of the explicitness of the prompts provided) is what changes.

Prompts, which are intended to activate elaboration, vary through a series of five stages from maximally explicit prompts in which the subject witnesses interaction between the actual referents of the items, to antagonistic prompts in which the subject is required to repeat the noun pairs as many times as possible so as to preclude facilitative elaboration. This model is presented in Figure 2. As seen in the illustration, prompts consist of: (a) maximally explicit prompts--defined above; (b) augmented explicit prompts--items are presented in the context of a sentence or illustration provided by the experimenter; (c) explicit prompts--the subject is directed to create for the two items a "referential event" such as a sentence or picture

which presents the items in an interaction; (d) minimally explicit prompts--the subject is told merely to learn the material for subsequent retest; and (e) antagonistic prompts--defined above.

FIGURE 2

ROHWER'S (1973) CONCEPTION OF PROMPTS AS ELABORATIVE STRATEGIES IN PAIRED-ASSOCIATE LEARNING


degree of prompt
maximally explicit (S observes interaction)
augmented explicit (E provides sentence or picture)
explicit (S generates sentence or picture)
minimally explicit (control)
antagonistic (rote repetition of each noun pair)

The distinction between manipulation of materials and training of prose learners has also been discussed at length by Frase (1972) and by Rothkopf (1970). The major contention by Rothkopf is that what is learned by the reader depends largely on the reader's activities, not the manipulation of materials. These activities are referred to as "mathemagenics"--the student's activities that are relevant to the achievement of specified instructional objectives.

A substantial body of research has been conducted in the area of pictures as adjunct aids, and instructions to form images corresponding to what is being read. A separate body of research has been concerned with investigations into the facilitative effects of verbal strategies (these studies will be summarized in the next chapter). However, there have been few attempts to compare the effects of verbal and pictorial strategies in prose-learning situations.

Although both types of techniques have been shown to be facilitative, they may be differentially so for different types of materials (Franks & Bransford, 1974) or different learner types (Levin, 1973). Resgold, Curtis, DeGood, Golinkoff, McCormick, and Shimron (1975) have suggested that both verbal and pictorial strategies are probably equally facilitative, and that what is important in comprehension is the degree of elaboration applied by the reader to the text material. It seems worthwhile, however, to compare verbal and pictorial strategies in a systematic investigation to determine their relative facilitation.

The present study is concerned with determining the effectiveness of certain elaboration strategies when compared to simple instructions to remember text material. Fifth graders were instructed to read a passage, and according to experimental condition, either to read the passage and generate images or verbal summaries relating to the passage content; or to read the passage while attending to adjunct pictorial or verbal elaboration of the passage. Based on the models underlying Figures 1 and 2, it was expected that readers of low ability would benefit more from the elaboration strategies than would the high ability readers. Furthermore, low ability readers would benefit more from the imposed adjunct illustrations and verbal summaries than they would from the induced strategies in which they were required to generate their own images or verbal summaries. This prediction is also based on the models underlying Figures 1 and 2 which

assume that more imposed elaboration (Figure 1) or more explicit prompts (Figure 2) are necessary to facilitate performance for readers of low ability.

Not all of the information contained in the text was presented in the illustrations/verbal summaries. The present study was designed to take advantage of this: The posttest questions were constructed so that half of them were based on information that was also presented in the illustrations/verbal summaries; and half were based on information that appeared only in the text. In this way, it was possible to determine if adjunct materials would facilitate not only memory for information highlighted in the adjunct materials, but also related information which appeared only in the text. The studies that have been conducted to test this hypothesis will be discussed later in this paper.

Chapter II

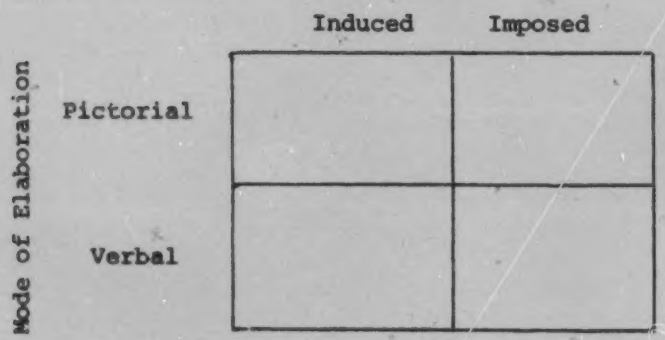
REVIEW OF THE LITERATURE

A model of text comprehension emerges in which comprehension is improved by elaboration of the passage. As stated previously, this elaboration may be imposed on the reader by providing some adjunct aids which make the text more comprehensible, or induced in the reader by instructions to adopt some facilitative strategy. Furthermore, these elaborative strategies may be either pictorial or verbal. Pictorial elaboration consists of providing adjunct pictures which relate to the text (imposed), asking the subject to draw illustrations of what he is reading (this strategy falls somewhere along the continuum between induced and imposed) or instructing the reader to generate images corresponding to the text (induced). Verbal elaboration consists of providing verbal summary statements corresponding to sections of the text (imposed), requesting the reader to respond to specific questions pertaining to the text (also somewhere along the continuum between induced and imposed), or instructing the subject covertly to summarize or paraphrase each paragraph (induced). If the subject is instructed overtly to summarize or paraphrase the text, then the elaboration again falls along the continuum between induced and imposed because the product of the elaboration is available to the subject (similar to when the subject generates his own illustrations).

Keeping in mind that there has thus far been little or no prose-learning research conducted with purely induced verbal elaboration, one can visualize an idealized 2 by 2 matrix of elaborative strategies as in Figure 3 (see Levin, 1972b, who developed the matrix for cataloging paired-associate learning phenomena). The situation is not dichotomous as the figure suggests; it must be remembered that some elaboration falls somewhere between induced and imposed (for both pictorial and verbal alike). Before proceeding to a consideration of: (a) the prose research that corresponds to each of the four cells; and (b) comparisons between the relative facilitative effects associated with each cell, the paired-associate learning research which has been the basis for much of the reading research to be reported in this paper will be reviewed.

FIGURE 3

MATRIX OF ELABORATIVE STRATEGIES
(From Levin, 1972b)



The paired-associate learning task is a research paradigm which has been used extensively to investigate basic learning processes. It is derived from the assumption that learning consists of a pairing between two initially unrelated entities (for example, when a child first makes the connection between an object and its corresponding verbal symbol). We may further assume that more complex learning is based on the same process--constructing a relationship between two previously unrelated entities. If this is in fact the way learning occurs, then the paired-associate learning task provides an opportunity to observe and manipulate the process in a controlled laboratory environment.

The extensive research into paired-associate learning has uncovered a set of consistently demonstrated variables that determine the degree of successful learning when the material to be learned consists of isolated pairs of unrelated items. A logical next step is to extend these findings to include investigations of the same variables when the material to be learned is meaningfully connected, such as text. As will be seen, the leap is sometimes greater than anticipated because of the increased number of dimensions that must be considered when the researcher deals with meaningful text.

Because of previously demonstrated correspondence between findings in the areas of paired-associate learning and memory for text, the relevant literature in both areas will be presented, beginning with the former. It will be seen that this body of

paired-associate learning research investigates the elaborative techniques of interest to the present investigation.

Elaboration and Paired-Associate Learning

Imposed Verbal and Pictorial Elaboration

Typically, elaboration techniques in paired-associate research involve providing some form of interaction between the paired items. Pictorially, this interaction involves some meaningful combination of the two items (for example, given the paired nouns, FOOT-SUN, the subject might be presented with a picture of the foot stepping on the sun). Verbally, this interaction consists of a sentence or phrase which describes the interaction between items (e.g., "The foot steps on the sun."). Unlike the prose learning research, the stimuli can be pictorial as well as verbal. That is, in some investigations the subject is presented only pictures without any verbal labels. In addition, many of these investigations have been developmental, focusing on children from kindergarten through sixth grade.

For example, a series of studies has been conducted to compare the relative effectiveness of imposed visual, verbal and combined visual and verbal elaboration in paired-associate learning. Rohwer, Lynch, Suzuki, and Levin (1967) presented picture pairs to children in first, third and sixth grades to determine the effects of verbal and visual elaboration. Pictures presented either side by side, combined in some interaction, or involved in animated

action were verbally elaborated using either conjunctions (control), prepositions, or verbs (which corresponded to the visually depicted action). The authors found that facilitation occurred with either sentence descriptions or pictorial presentations of relationships between the two objects. There was no increased facilitation when both modes were elaborated compared to facilitation with either mode alone.

These findings were extended by Rohwer, Lynch, Levin, and Suzuki (1968) to a comparison between children from schools with high standardized test scores and children from schools with low standardized test scores. Experimental conditions included side by side versus action involvement of picture pairs, and verbal accompaniment of the pictures' verbal labels either separately, or combined in phrases or sentences. No differences in relative facilitation was found between high and low school strata children, and the results supported the findings of Rohwer et al. (1967): namely, that action was better than still presentation, and sentence elaboration was better than naming.

A study was conducted by Davidson and Adams (1970) in which second graders' paired-associate recognition was measured for picture pairs which were verbally or pictorially elaborated. The paired pictures were either side by side or joined in an interaction (visual elaboration). Verbal elaboration consisted of either prepositional ("the rope around the jar") or conjunctive phrases ("the rope and the jar"). Visual and verbal modes were

crossed with interaction and no interaction to form four experimental conditions. Analysis of the data revealed that average performance in the three mediated conditions was better than in the nonmediated condition. Furthermore, prepositional joining of side by side pictures facilitated learning more than joined pictures without accompanying prepositional phrase. Similar investigations (e.g., Reese, 1965; and Milgram, 1967) have discovered comparable results. One of these studies by Milgram will be reviewed below and a discussion of the hypothesized superiority of verbal over pictorial elaboration will be presented.

Milgram (1967) tested a hypothesis proposed by Bruner (1964), namely that with increasing age children shift from a predominantly iconic mode of representation to a symbolic one. This transition is supposed to occur at about age six after which there exists an increasing importance of verbal over pictorial modes of processing. To test this, children aged 4, 7, and 9 were presented with pairs of pictures which were either side by side (control) or combined in an interaction. Subjects presented with combined pictures were instructed either to trace around the outline of the pair (visual) or to repeat sentences corresponding to the depicted interaction (verbal). Control subjects were instructed to trace imaginary circles around each item (side by side). Tracing in the control and visual conditions was to guarantee that subjects were attending to the stimuli.

Milgram found that for seven and nine year olds, both

experimental conditions were better than the control. While for the four year olds, the verbal condition was better than the control, whereas the visual condition was not. The data suggested to the author that the verbal mode is facilitative across the age span in question, while visual facilitation develops over this period. These results which are contrary to predictions based on Bruner's hypothesis are consistent with Bower's (1969) suggestion that pictures have an implicit grammar similar to the laws of Gestalt perception. Young children do not benefit from visual interactions because they must deduce the implicit connective which joins them, which is not the case when they are given a sentence which explicitly states the connective (i.e., a verb).[2]

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[2]Elkind (1969) has discussed a series of studies which demonstrate that there is a developmental progression from figurative to thematic perception: young children merely enumerate the individual elements of an interactive scene, children of six years begin to describe the interactions; and by eleven they accurately unite the elements into a complete theme. However, Horowitz, Lampel, and Takanishi (1969) contend that the stage of transition to thematic perception occurs at about four years of age; while Jones (1973) offers evidence that this occurs at about age two. Whether this discrepancy is a function of particular subject characteristics or task demands, or even of generational differences remains to be settled. Reese (1974) offers data suggesting that such findings may be a function of a "Sesame Street" effect. Based on the reanalysis of data collected before and after the appearance on television of that program (November 1969), he found that very young children benefited more from elaboration (of pictorial materials presented in a paired-associate task) after November 1969 than before. This improved performance may reflect a one to two year acceleration in cognitive ability.

The hypothesis that two modes of presentation should yield better performance than a single mode has also been tested by Odom and Nesbitt (1974). Children in kindergarten and fifth grade were presented stimulus pairs in one of two modes (verbal or pictorial) which were presented either in interaction or not. The experimental conditions were such that the children experienced either verbal and pictorial interaction combined, pictorial or verbal interaction singly; or neither pictorial or verbal interaction. When no interaction was presented, the objects were pictorially presented side by side, and the verbal labels were presented in separate sentences appearing side by side. In all conditions, both verbal and pictorial stimuli were simultaneously presented.

The results indicated that there was no interaction between age and mode of elaboration; both age groups benefited similarly from the two modes of elaboration compared to the control. However, as predicted, the condition in which subjects were presented both visual and verbal elaboration, performance was better than when only one mode of elaboration was presented (visual or verbal). The authors interpreted these results as supporting the dual-coding model proposed by Paivio (1971) and others. That is, stimuli which are processed through two modes will lead to better retention than when processed in only one mode.

There is no obvious reason why Odom and Nesbitt found two-mode facilitation to be better than one-mode, while previous research

by Rohwer and associates, and Davidson and Adams found comparable facilitation between two modes and one mode. The Davidson and Adams study measured recognition and obtained results similar to those of Rohwer who measured recall, just as did Odom and Nesbitt. There appears to be no ceiling effect in the Davidson and Adams or in the Rohwer investigations. The only obvious difference between these studies exists in the materials--Odom and Nesbitt presented their non-relational words in separate sentences (e.g., The foot was large The sun was bright) while Davidson and Adams, and Rohwer et al. presented these words joined by a conjunction in one phrase (e.g., the rope and the jar). Why these different stimuli should lead to different results is not clear. Possibly, the separate sentences may draw the subject's attention more to the separate objects, thereby depressing the interaction effect. It would be informative to compare both stimuli in one experiment.

The investigations presented in this section offer an inconsistent picture of the relative effectiveness of pictorial and verbal imposed elaboration techniques. The evidence strongly suggests that there <u>is</u> a developmental shift toward the ability to "read" pictorial elaboration, but the age at which this occurs is not clear and may be a function of the task characteristics. The review does demonstrate that either pictorial or verbal elaboration is facilitative in children's paired-associate learning, and that elaboration in either mode (verbal or pictorial) is

generally sufficient (with the exception of the findings of Odom and Nesbitt) to reach the threshold of improved performance. Any further elaboration (i.e., in both modes) does not have an increased effect.

Induced Verbal and Pictorial Elaboration

The paired-associate studies thus far discussed have imposed upon the learner the elaboration which facilitated learning. This facilitation consists of presenting either the stimulus pictures in some combined interaction and/or a sentence along with the picture which describes an interaction between the depicted objects. The studies which follow induce the learner to create his own elaboration for the stimulus pair. That is, the subject is typically instructed to construct a "picture in his head" or a sentence which combines the stimuli in some meaningful interaction. After these studies are discussed, a study will be presented which compares the effects of both induced and imposed elaboration.

One such study by Levin, Davidson, Wolff, and Citron (1973) compared the effects of induced imagery and sentence elaboration on the recognition and recall of picture and word paired associates. Second and fifth graders were instructed to make up a picture and/or a sentence in their heads of the two paired items doing something together. Compared to a control group left to their own devices, all three experimental conditions performed significantly better, with no differences among experimental conditions.

For all conditions and both grades, pictures were remembered better than words. This finding was tempered for the second graders by an interaction; the sentence strategy was descriptively the poorest condition for words but the best strategy for pictures. Post hoc analysis confirmed this reversal of the sentence strategy relative to the other two strategies. This interaction was not present at the fifth-grade level. This finding is consistent with the findings of previous research with pictures as stimuli which has demonstrated that the ability to benefit from verbal (sentence) elaboration develops before the ability to benefit from pictorial elaboration. Why this same developmental trend does not appear when the stimuli are words has not yet been answered. As in the Davidson and Adams (1970) and the Rohwer et al. (1968) imposed elaboration studies, the combination of both pictorial and verbal elaboration did not yield performance superior to that obtained from single-mode elaboration; again supporting the hypothesis that a certain threshold amount of elaboration is sufficient to facilitate performance after which increased amounts have no effect.

Levin (1972b) reports data collected on sixth graders who were presented with one of three types of stimuli in a paired-associate learning task: words, pictorial representation of the words, and sentences which contained the words, under imagery or regular instructions. This procedure consists of a combination of imposed verbal elaboration (sentences) with induced pictorial

elaboration (instructions to image). Of particular interest to the present investigation is the finding that imagery instructions with sentences increased performance over sentences alone. Similarly, Levin, Ghatala, Guttmann, Subkoviak, McCabe, and Bender (in press) found that children's learning of information in discrete sentences was facilitated by imagery instructions.

Finally in this review of elaboration in paired-associate learning, a study which most closely parallels the present study, was conducted by Kerst and Levin (1973) in which comparisons were made between verbal and pictorial imposed and induced strategies on paired-associate learning of pictures by fourth and fifth graders. Each experimental condition was significantly different from control, though not from one another. The authors did notice, however, that the variance of the two induced strategies (pictorial and verbal) was considerably greater than the two imposed strategies. This was interpreted in terms of greater individual differences in subjects' ability to generate their own elaboration than to use an experimenter-provided one. The purpose of the present prose-learning study closely corresponds to that of Kerst and Levin (1973). In addition, ability differences which were suggested by the Kerst and Levin data were considered; and in particular, in interaction with the various elaboration conditions. Following a discussion of ability differences in paired-associate learning, a review of research on elaboration in reading will be presented. At that point, ability differences in reading tasks will be considered.

Ability Differences in Paired-Associate Learning

A substantial body of paired-associate learning research has been concerned with the differential facilitation of elaboration for subjects of high and low ability. Recall that Rohwer et al. (1967) found no differences in ability to benefit from imposed verbal and pictorial elaboration for children with either high or low standard achievement test scores. In a study by Cooper (1968), fourth grade children were separated into good and poor readers based on a standard reading achievement test, and instructed to make up interaction sentences for picture pairs, or simply learn which pictures went together. There was no difference in trials to criterion between good and poor readers in the mediation condition (1.62 vs. 1.12 respectively), while there was a significant difference in the non-mediation condition (6.75 vs. 11.62). Furthermore, when asked whether or not they used mediation, good readers in the non-mediation condition reported significantly more spontaneous mediation than the poor readers.

Similar research (Davidson, 1964; Rohwer, Ammon, Suzuki, & Levin, 1971; Rohwer & Bean, 1973; Semler & Iscoe, 1963; Stevenson, Friedericks, & Simpson, 1970) has arrived at the same conclusion: Both high and low ability groups benefit from elaboration; elaboration brings the low ability group up to at least the level of performance of the high ability group when left to their own devices (see the discussion of ordinal aptitude-by-treatment interactions by Levin, in press).

Rohwer (1970) states that children who perform well on paired-associate learning tasks engage in a transformation of the stimuli. Furthermore, proficient learners will generate some form of elaborative conceptual activity to achieve mastery no matter what the task may be. High ability (reading achievement, IQ, etc.) children have learned to elaborate materials to-be-learned while low ability children have not. When provided with a suitable strategy, low ability children begin to demonstrate performance similar to high ability children. This finding will also be discussed later on in this review when high and low ability children are compared on reading performance.

The paired-associate learning research presented here has investigated the effect of facilitating memory for picture and word pairs using verbal and pictorial modes of induced and imposed elaboration. The results indicate that all strategies are significantly facilitative for the child. However, verbal elaboration seems to occur before pictorial elaboration. Elaboration in one mode, verbal or pictorial, is sufficient to facilitate memory; two modes do not noticeably enhance performance above this level. Because older and high ability children appear spontaneously to engage in elaboration of to-be-learned materials, while younger or low ability children do not, under elaboration conditions the latter children have often been found to benefit the most from elaboration techniques being up to at least the level of performance of the former children left to their own devices.

Elaboration and Text Comprehension

Just as elaboration has been used in paired-associate learning research, similar techniques have been extended to investigations of comprehension and memory for textual material. Both verbal and pictorial modes have been extensively manipulated in prose learning research. However, up until quite recently, only pictorial elaboration techniques have been extended from paired-associate paradigms. Only a few reading studies have investigated verbal strategies which are comparable to strategies used in paired-associate learning. A substantial body of verbal elaboration research has grown out of the use of questions placed throughout the text. This review will first consider the pictorial strategies and then the verbal strategies.

Basically, three methods of pictorial elaboration have been employed: (1) subject-generated imagery, (2) subject-generated illustrations, and (3) experimenter-provided illustrations. These three methods represent the extreme cases of induced and imposed elaboration (1 and 3 respectively), as well as a strategy which falls somehwere along the continuum between these extremes (2).

Subject-Generated Imagery

Instructions to image have repeatedly been shown to be a facilitative learning strategy for processing textual materials. Typically, the subject is instructed to read or listen to part of a passage and then pause and form an image corresponding to what

he has read or heard. The unit of text for which the subject is instructed to image varies from the sentence (e.g., Levin, 1973; Levin, Divine-Hawkins, Kerst, & Guttmann, 1974) to the paragraph (e.g., Lesgold, Curtis, et al., 1975; Pressley, in press).[3] Basically, the subject is instructed to make up "mental pictures" corresponding to what is going on in the text. That imagery may be a good comprehension strategy was suggested by Anderson and Kulhavy (1972), and by Anderson and Hidde (1971). After obtaining nonsignificant results between two groups of adult subjects, one instructed to image to a passage and the other not given imagery instructions, Anderson and Kulhavy (1972) questioned the subjects and found that half of the control subjects reported spontaneously imaging to the contents of the text as part of their normal comprehension strategy, while half of the experimental group did not image even though instructed to do so. A post hoc reanalysis of the data comparing those subjects who reported imaging with those who reported not imaging yielded results demonstrating the effectiveness of imagery as a comprehension strategy. Although the results are based on a post hoc analysis, the data suggest that some conscious mental processing

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[3]The importance of the size of this unit has been considered by Guttmann (1976). He suggests that by segmenting a passage into units which are to be organized by a unifying image, the reader is cued to what contents he should be combining in memory. As the size of this unit increases to paragraph length, it is necessary for the reader to combine more information in memory, whereas when the unit is the sentence, less information must be combined.

activity is being employed by readers with superior comprehension. The results also suggest that mature readers have established reading behaviors which are not easily modifiable by experimental instructions.

In a study that sought to avoid the established reading habits of adults, Kulhavy and Swenson (1974) tested the effect of imagery on text learning with fifth- and sixth-grade subjects. They reasoned that imagery instructions should increase semantic processing, and since the meaning of text is recalled better over time than its rote form, memory for meaning (as reflected by answers to paraphrase questions) should become more pronounced over time when learning is accompanied by imagery. The results of the study supported this interpretation: Imagery instructions increased memory of the passage, especially its meaning over time.

A series of experiments will be discussed here because they are the only ones of their kind in the literature thus far. They are relevant to this section and also to following sections on experimenter-provided and subject-generated illustrations. However, they should be viewed with great caution because of the lack of reporting of relevant information, apparent inappropriate control of extraneous variables, and the possible inaccurate analysis of data.

The first of these studies by Gibbons and Boutwell (1972) was an attempt to go beyond the imagery research which used passages specially constructed for the situation (resembling paired-associate

verbal elaboration) to passages typical of what might be contained in textbooks. The 2500-word passage was taken from a history textbook. The authors did not specify the age of the subjects, but it is assumed that they were college age. Compared to a control group instructed to read only, there was no facilitation due to instructions to image.

A subsequent study by Rasco, Tennyson, and Boutwell (1975), also with college age subjects, found a small nonsignificant effect due to imagery instructions (although the authors reported it to be significant). The same study with highschool seniors yielded no differences between the imagery condition and control. Apparently, the differences found with specially constructed passages (containing a story line) may not exist when the passage is of the textbook variety. Or, the lack of effect might be due to inability of mature readers to comply with instructions as was suggested by Anderson and Kulhavy (1972). What should have been done here was to use younger subjects with the same instructions. Rasco, Tennyson, and Boutwell did conduct a study with fourth and fifth graders, but they substituted instructions to draw for instructions to image.

Abstract Versus Concrete Materials

Because imagery is assumed to produce mental pictorial representations of what is to be learned, it might be assumed that stimuli which are very concrete are also more imagible.

In fact, according to the results of research by Paivio and his associates (e.g., Begg & Paivio, 1969), comprehension of concrete text materials (i.e., those including descriptions of concrete referents and events) should benefit most from imagery instructions. To test this, Andrasik et al. (1974) first segmented a passage into phrase units which were psychologically meaningful; then they obtained subjective ease-of-imagery ratings; and, finally, they presented the passage to adult subjects who were tested either in an immediate or a delayed condition. High imagery phrases were found to be best remembered in immediate testing and over time. There was a slight nonsignificant superiority of recognition for high imagery phrases. These findings led the authors to conclude that high imagery phrases were being coded as nonverbal spatial units while abstract phrases were coded in memory as verbal sequential strings or much less distinctive images. However, recall that Johnson, Bransford, Nyberg, and Cleary (1972) have found that abstract sentences are more difficult to comprehend initially; this may be the reason for Andrasik et al. obtaining the results that they did. Thus, the superior recall of concrete sentences may not be due to their improved imagibility, as Paivio (1970) suggests, but instead a result of the difficulty with which abstract sentences are initially comprehended. Further on in this review, other hypothesized reasons for why imagery is thought to improve comprehension will be discussed.

In two experiments reported by Lesgold, Curtis, et al. (1975),

adult subjects were instructed either to image or not while reading concrete or abstract passages during a specified time limit. The only difference between conditions was that the imagery group did better on the first half of the passage but worse on the second half relative to the control group, suggesting that imaging while reading was effective but took longer than reading alone. Subjects who imaged might not have been able to finish the passage, thus depressing their overall response scores. Subjects in a second experiment were allowed to read at their own pace and also to draw pictures corresponding to the passages. According to the distinction described earlier, the elaboration strategies were shifted from induced in Experiment 1 to imposed/induced in Experiment 2 (imposed because the subject was able to look at the product of his elaboration, i.e., the actual illustration). However, the authors expressed little concern for this shift. As expected, the experimental group did significantly better than the control for both concrete and abstract passages, indicating to the authors that visual elaboration is just as effective in improving comprehension for both types of passages. (In addition to this, they speculated that pictorial strategies may be better for concrete passages while verbal strategies may be better for abstract passages, a position also expressed by Paivio, 1971.) Unfortunately, since both the time allowed to read, as well as instructions to draw rather than to image, were modified between Experiments 1 and 2, it is not possible to determine which factor was accountable for the obtained results.

Imagery and Children's Prose Learning

Children as well as adults have been instructed to form images corresponding to what they read. While adults benefit from imagery--an induced pictorial elaboration--with young children (five to seven year olds) it is necessary to move more toward imposed elaboration strategies; these subjects are unable to benefit from strategies which are purely imposed on them by the experimenter. Research concerned with paired-associate learning in young children (e.g., see Levin, in press) has found it may be necessary to involve the child in active manipulation of the stimuli or at least to instruct the child to prepare for such manipulation. Research has also shown (Guttmann, 1976) and Lesgold, Levin, Shimron, and Guttmann (1976) have suggested that there is approximately a two-year lag between children's ability to benefit from imaginal elaboration in paired-associate learning and in prose; the former occurring at about six years of age and the second at about eight years. The authors suggest that the difference may be due to the added task of keeping track of the context in prose while this is not necessary in paired-associate learning in which inter-pair relationships are arbitrary and unimportant.

Guttmann (1976) investigated the developmental progression of young children's ability to benefit from imagery instructions. Subjects in kindergarten, second and third grades listened to a passage and were assigned to one of four conditions. Two of these conditions, control and instructions, are of interest to the present

discussion. The other two conditions will be discussed in detail in a later section. Based on the results of short-answer testing, only third graders were able to benefit from imagery instructions compared to control; kindergarten and first grade subjects did not benefit from instructions to image.

Another investigation into young children's ability to benefit from imagery instructions was conducted by Shimron (1974) who orally presented stories to first and fourth graders under one of four conditions, two of which were imagery instructions and control (again, the other two conditions are not of interest to the present discussion but will be presented later). There were no significant differences between conditions for free-recall and recognition testing. In a subsequent experiment, responses to short-answer testing yielded significant imagery-over-control results for fourth graders, but not for first graders.

Whereas the just-mentioned studies have tended to be positive regarding the effect of imagery instructions on children's listening comprehension for third and fourth graders with short-answer tests, they are less so in studies of children's reading comprehension (see Levin & Divine-Hawkins, 1974). In another experiment reported by Lesgold, Curtis et al. (1975), for example, third and fourth graders were given the imagery-drawing instructions that had been used with adults, but the results were nonsignificant. The authors suggested that what is required for imaging and reading a passage may be too much for young subjects to do. Facilitative pictorial

and imagery effects occur with fourth graders when passages are presented one sentence at a time and testing consists of multiple-choice questions, but not with whole passage presentation and paraphrase recall--procedures which are effective with adults (Rohwer, 1970). Lesgold, Curtis et al. (1975) speculated that a training procedure might enable third and fourth graders to benefit from imagery instructions.

Imagery Training Procedures with Young Children

The idea of training young children to generate their own facilitative elaboration has been successfully applied in paired-associate learning research. Danner and Taylor (1973), Yuille and Catchpole (1973), and Varley, Levin, Severson, and Wolff (1974) have demonstrated that young children (kindergarten and first grade) who do not appear able to generate pictorial elaboration following simple instructions can be taught to do so through brief training sessions. These sessions typically consist of presenting to the children objects to play with or draw, or pictures of objects in interaction. Later, in the learning situation, the children are expected to imagine the object pairs in some meaningful interaction. The results generally demonstrate that this procedure

greatly improves performance.[4]

A training procedure has been used in reading research by Lesgold, McCormick, and Golinkoff (1975) in which third and fourth graders were trained on what a mental image should consist, and how to select the main points of a passage for use as main themes in their images. Effective training should consist of the ability to process in turn every assertion of a passage and to coordinate these verbal representations into a general nonverbal context. When subjects were reminded to use imagery on a posttest involving a passage similar to that used in training, significant imagery effects were obtained. However, an attempt to determine the generalizability of the training procedure by measuring performance on a standardized reading comprehension test yielded no significant differences between experimental and control groups. Furthermore, even when in a second experiment, subjects who were trained to use imagery were given explicit instructions to image on the standardized comprehension test, no difference was obtained between them and controls.

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[4]Regarding training through actual manipulation of objects, Bender and Levin (in press) have demonstrated that this may not be necessary to induce imagery in young children. By instructing kindergartners to plan how they would make toy objects interact, but not actually allowing them to perform the interaction, the children were able to significantly improve performance compared to controls instructed to simply form images.

Pressley (in press) also attempted to determine if young children (eight years old) could benefit from imagery instructions. These subjects were trained to make up images of successively longer prose passages (sentences, paragraphs, and a whole story of 950 words) consisting of sentences which were similar to paired associates combined into bizarre interactions (e.g., "A cow came along bouncing a basketball."). The author obtained a significant (though small) difference between subjects trained to pause and image after designated segments, and controls instructed to do whatever was necessary to aid their recall of the story. Although the design does not allow for the results to be definitely attributable to the training procedure alone (there was no control condition in which imagery instructions were given without training), the training procedure lasted only about 15 minutes and, in fact, can be considered a multiple example shaping procedure which is little different from most imagery instruction procedures and certainly less than the Lesgold, McCormick, and Golinkoff (1975) four-week training procedure.

Why are Instructions to Image Facilitative?

Suggestions have been put forth to determine why imagery facilitates comprehension. Imagery may be an effective prose-learning strategy because it represents text information more simply. Paivio (1971) proposes that imagery may more effectively chunk or unitize information thereby making it easier to retain

than when it is in the sequentially organized pattern of verbal representation. Lesgold, Curtis et al. (1975) suggest that another way in which imagery may aid prose learning is by providing a context or foreground for the passage.

Levin and Divine-Hawkins (1974) suggest that although instructions to use imagery may be a good learning strategy, it may not necessarily be a good reading comprehension strategy. Forming an image may serve to improve learning because it provides an effective organizational strategy for the material to be learned. But for material that is already well organized, such as a prose passage, visual imagery instructions are less likely to be facilitative. Basing their argument upon evidence suggesting that there exist separate internal cognitive systems (e.g., Atwood, 1971; Brooks, 1968), one for processing visual information and one for processing auditory information. These authors also suggest another possible reason why imagery may not be an effective reading comprehension strategy. If imagery is a visual process, then imaging and reading a passage simultaneously would result in competing behaviors which would be less efficient than listening to and imaging a passage, behaviors that would utilize both the visual and auditory systems. Data consistent with this interpretation were presented by Levin and Divine-Hawkins (1974).

In summary, the body of imagery in prose research yields several consistent results. There appears to be a developmental trend in the ability to benefit from imagery instructions which

do not contain adjunct aids such as pictures. The transition from the need for imposed elaboration to the ability to benefit from induced elaboration occurs at about age eight or nine years of age. More will be said about this when Guttmann's (1976) research is discussed below in which he attempts to demonstrate this developmental transition. Furthermore, imagery in conjunction with listening seems to be relatively more facilitative than imagery in conjunction with reading.

Subject-Generated Illustrations

The elaboration procedures discussed in this section fall along the continuum between induced and imposed. Some of these strategies are more in the direction of induced: the subject must generate his own drawing or cartoon; others are more in the direction of imposed: the subject is required to manipulate materials provided by the experimenter into an illustration of the passage.

A series of investigations was conducted by Lesgold, Levin, et al., (1975) to determine if first graders are able to benefit from pictorial augmentation of aural prose, and if so, what variables are actively responsible for the facilitation. These authors utilized background scenes and cutout objects which could be placed on them to illustrate the text. In Experiment 1, after having heard a passage, subjects were required to select an appropriate background and cutouts and use them to illustrate the passage.

Contrary to expectations, this group did worse on recall than did a control group who merely heard the passage. However, a positive relationship was found to exist between the quality of a subject's illustration and recall. This prompted the authors to speculate that deciding which background and cutouts (out of a large array of 30 cutouts) were appropriate to illustrate the passage was confusing to the subjects and thus leading to decreased performance.

Experiment 2 was designed to overcome this problem by providing the subject with the appropriate background and cutouts with which to illustrate the passage. These first graders significantly outperformed controls whether they illustrated the passage after each sentence or at the end of the passage, or whether they or the experimenter performed the illustration.

To determine if selection by subject of appropriate background and cutouts was the significant factor, conditions in which subjects did or did not have to make selections were compared. While there was no significant difference in free recall between each of these conditions and control, experimenter-selection resulted in descriptively better performance. Additionally, cued recall resulted in experimenter-selection yielding significantly better performance than control, while subject-selection did not differ from control.

This series of studies demonstrates that first graders benefit from pictorial augmentation when selection of the appropriate illustration contents is made by the experimenter. Who does the

illustration--subject or experimenter--is not as important, nor is whether illustration occurs after each sentence or at the end of the passage.

Subject-generated illustration has also been investigated by Snowman and Cunningham (1975) with adults as subjects. A review of this research, which compares illustrations to verbal responses to questions, will be presented later on in this paper.

Experimenter-Provided Illustrations

Pictures which illustrate text typically have been used in two different ways: either as prefamiliarizing aids before the passage is read, or during the reading of the passage. Lesgold and DeGood (1973) and Bransford and Johnson (1974) presented a picture to subjects before the passage. The intention of providing the picture was to relate the information in the passage to the reader's existing knowledge. Unlike pictures used in this way, pictures presented during the passage are believed to aid in the organization of the ideas within the passage.

Pictures as adjunct aids have been used by Rohwer and Matz (1975), Rohwer and Harris (1975), Guttmann (1976), Peeck (1974), and Lesgold, Levin, et al. (1975) to augment or replace oral presentation of the passage. Rohwer and his associates reasoned that pictures would serve to organize the context of the passage, thus relating elementary ideas within the text.

Rohwer and Matz presented stories orally to high and low SES fourth grade subjects. The stories consisted of a series of

sentences, each of which contained an assertion. The format of these assertions is described by the set: A's are B's, B's are C's, C's are D's, and D's are E's. An example of a sentence from one of the passages is "The curly-tailed monkeys like to watch their children." Later, the subjects were asked to agree or disagree with explicit assertions such as A's (curly-tailed monkeys) are B's (like to watch their children) or implicit ones such as A's are E's. To respond to the correct implicit assertion, a subject would have to process two, three, or four sentences together. In addition to the oral presentation of sentences, the experimental group was presented with pictures. Each picture corresponded to the sentences and they were cumulative in that as each sentence was read, corresponding picture parts were added to the composite picture. Control groups were presented with the sentence in print along with the oral presentation. Consistent with predictions, the experimental group performed significantly better than the control group for both high and low SES subjects.

Rohwer and Harris (1975) conducted a similar study with fourth graders using the same stimulus passages but added the conditions oral alone, print alone, and pictures alone to determine if pictorial augmentation facilitated performance or if printed augmentation depressed it. The results of this investigation showed that pictorial augmentation to oral presentation produced superior performance over oral plus print in two ways: for low SES subjects, oral plus pictures was better than oral alone; while for high SES

subjects, oral plus print was worse than oral alone. The authors could offer no plausible explanation for these latter results.[5]

In a review of research which investigated the facilitating effects of pictures on comprehension, Samuels (1970) concluded that the bulk of research suggests that comprehension is not affected in any measurable way when pictures are used as adjunct aids. According to Samuels, the only way illustrations could influence comprehension would be for the picture to convey information that is relevant to the questions asked on a test; but even then the reader must determine which parts of the picture are relevant and which are not.

For example, a series of experiments was conducted by Vernon (1953, 1954) in which she attempted to obtain memory facilitation with the use of illustrations depicting text. The first of two experiments of particular interest to the present review (Vernon, 1954) was conducted with children 11 to 12 years of age and used children's stories of 755 and 940 words in length. Based on the results of a short-answer test, there were no significant differences in performance between children who read illustrated passages and

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[5] A possible explanation may be found in the work of Levin, Horvitz, and Kaplan (1971), and Kaplan (1971), however. Fifth grade children performed better on paired-associate and reading tasks when they saw the critical stimuli alone in print and heard an accompanying verbal description, than when they both saw the print and heard the description. One suggestion given by these authors was that listening while reading may be unprofitable, causing the subject to attend to the sequence of words in the sentence, without actually comprehending the message.

unillustrated passages. In an attempt to increase the amount of attention paid to the illustrations by the subjects, Experiment 2 was conducted with orally presented passages. Again, however, there were no significant differences due to illustrations. Though not statistically analyzed, items appeared to be recalled more frequently when depicted than when not depicted. The author speculated that items not depicted were overlooked or forgotten because relatively less attention was given to them.

A thorough investigation into the facilitative effects of illustrations on comprehension by Peeck (1974), however, has demonstrated that pictures can, in fact, improve prose learning. The author sought to compare fourth graders' memory for information contained exclusively in the text, exclusively in illustrations, or in both. Text which is not illustrated may benefit from illustrations by becoming associatively connected to the illustration, or illustrations might differentially favor elements from the text that are represented in the illustrations, at the cost of the remaining text elements. Results of this study demonstrated that illustrations improved learning of illustrated text, and though not statistically significant, suggested a trend in the direction of improved learning of unillustrated text.

In a series of experiments reported above in which some mature subjects were instructed to image while reading a textbook passage, other subjects were provided with concrete illustrations which represented abstract concepts contained in the passage.

Gibbons and Boutwell (1972) found significant facilitative effects of illustrations compared to control (compared to no significant difference due to imagery instructions). Rasco, Tennyson, and Boutwell (1975) also found significant illustration effects (though they reported them as non-significant) for college age subjects (compared to no significant imagery effects), while they found no differences for highschool seniors for illustrations (or imagery). These authors did find significant illustration effects compared to control for fourth and fifth graders. The effect was considerably larger for fourth graders than for fifth graders.

Additional support for the facilitative effects of pictorial augmentation is provided by Guttmann (1976) who sought to determine whether partially imposed imagery can be a facilitative prose-learning strategy at an age when fully induced imagery is not. The author attempted to provide support for the model depicted in Figure 1, namely that the ability to benefit from imposed elaboration develops with age (or ability), and that younger children require strategies imposed by the experimenter.

Subjects in kindergarten, second and third grades were assigned to one of four conditions (representing the continuum of Figure 1) in which they heard a passage and: (1) viewed pictures which fully illustrated each sentence of the passages, (2) viewed pictures which illustrated each sentence but omitted designated key objects, (3) received instructions to image, or

(4) were left to their own devices (controls). Based on the results of short-answer questions, kindergarteners benefited only from complete illustrations, second graders benefited from complete and partial illustrations (partial not significantly different from complete imagery or control, while complete was significantly different from imgery and control); and third graders benefited from complete, partial, and imagery relative to control. These results provide some support for the induced/imposed continuum model, and are consistent with the speculation of Lesgold, Levin, et al. (1975).

Similar elaboration procedures were also employed by Shimron (1974) with first and fourth graders who listened to stories and either: imaged what they heard, looked at backgrounds and cutouts which illustrated the stories, looked at backgrounds with cutouts placed below the background, or simply paid attention to the stories. There were no significant differences between conditions for free-recall and recognition testing, prompting a modified procedure for a second experiment. The condition in which background and cutouts illustrated the story was modified so that the subjects were required to illustrate the story by appropriately placing the cutouts on the background. There were significant effects based on responses to a short-answer test. For the first graders, control and imagery instructions were inferior to the two experimenter-provided picture conditions.

For the fourth graders, all three treatments, induced imagery and the two imposed pictorial elaboration conditions, were better than control. There was no significant difference for free recall testing.

The complete illustration condition used by Guttmann (1976) and the condition used by Lesgold, Levin, et al. (1975) in which the experimenter selected the appropriate background and cutouts are comparable in that they both fall on a similar point on the induced/imposed elaboration continuum; i.e., more toward imposed elaboration. Similarly, Guttmann's partial illustration condition and Lesgold, Levin, et al. (1975) condition in which the subject was expected to select the appropriate background and cutouts are both more in the direction of imposed on the elaboration continuum. In both studies, young children are shown to need imposed elaboration, but that with age, performance is facilitated by increasingly induced strategies.

The research presented in this section has rather successfully demonstrated the facilitative effects of illustrations used to elaborate passages for children and adults. This facilitation occurs when the illustrations correspond to each sentence or to each paragraph. The effect has been demonstrated when the passage is intentionally constructed to resemble a series of paired-associate verbal elaboration sentences, as well as when it is adapted from existing children's narrative stories. Finally, the use of illustrations has been found to support the model

of elaboration depicted in Figure 1--the child's ability to benefit from less imposed, more induced elaboration is developmental. As the child matures (between age six and ten), he is less in need of provided elaboration and more able to generate his own.

Reader Differences and Elaboration

The research presented thus far has been concerned primarily with the effects of various elaboration strategies for children of all ability levels. Exceptions are studies by Rohwer et al. (1968) and Rohwer et al. (1971) in which high and low SES children were compared on ability to benefit from elaboration. Recall the model depicted in Figure 1 which suggests that level of ability determines the facilitative effect of various strategies that vary along the induced/imposed continuum. Since the experimental manipulations were all imposed, the lack of significant difference obtained by Rohwer and his associates between low and middle SES groups would be expected (all children would be able to benefit from imposed elaboration). However, elaboration strategies which vary along this continuum should have differentially facilitative effects on children of different ability levels. Such an investigation has been conducted by Levin (1973) based on a model of text comprehension proposed by Wiener and Cromer (1967).

This model is based on the ability to organize passage contents successfully--good readers spontaneously organize, while poor readers

do not. Wiener and Cromer have identified several types of poor readers, two of which were "deficit" poor and "difference" poor. Deficit poor readers lack vocabulary skills and/or they cannot decode specific words. Difference poor readers, on the other hand, possess the prerequisite vocabulary and decoding skills but lack the organizational strategies that are characteristic of good readers. Both groups of poor readers are therefore unable to organize text, but for very different reasons. Cromer (1970) and Levin (1973) went on to demonstrate that "difference" and "deficit" reader types may be differentially affected by experimental treatments.

By dividing a passage into phrase units which organized successive individual ideas in the passage, Cromer (1970) was able to increase comprehension of the difference poor readers while deficit poor readers did not benefit. Difference readers, although they are able to comprehend individual words, do not recognize thought "units" and therefore are unable to comprehend a passage. By showing them where the units of meaning are, difference poor readers can improve their comprehension. This is not the case with deficit poor readers who do not successfully decode individual words and therefore would not be expected to benefit from organization of words into idea units.

Levin (1973) demonstrated that difference poor readers benefited considerably from imagery instructions, while deficit poor readers did not (but tended to benefit from illustrations corresponding to

the text). Students were classified as good or poor readers based on the results of reading and vocabulary subtests of the Iowa Test of Basic Skills. Good readers were those with reading comprehension scores at or above grade level, difference poor readers were those with below grade level reading comprehension and vocabulary scores less than one year below grade level, deficit poor readers were those with comprehension scores below grade level and vocabulary scores more than one year below grade level. Some students who were in classroom reading groups inconsistent with their placement determined by the above classification were reclassified accordingly. Fourth graders were presented 12-sentence stories or 12 cartoon-like drawings each corresponding to one of the sentences. Half of the subjects presented with the printed text were instructed to form images corresponding to each sentence.

Two major predictions, one dealing with pictures versus text, the other with imagery and text, were made by the author. Both were of interest in conjunction with reader types. The first prediction was that pictorial presentation would be more facilitative than text alone, especially for the poorer readers (after Rohwer & Matz, 1975). However, neither the picture versus text main effect nor its interaction with reader type materialized. Levin speculated that the reason pictures were not helpful may have been due to the fact that in the picture condition no verbal accompaniment was provided, unlike the Rohwer and Matz study where it was. Indeed, in a follow-up study by Rohwer and Harris

(1975), this speculation seems to be borne out in that a direct comparison revealed that pictures facilitated performance relative to printed text when the pictures were accompanied by an oral description of them but not when they were presented alone.

The second of Levin's predictions, that instructions to image would be more facilitative, was confirmed. Furthermore, difference poor readers were helped more by this strategy than were deficit poor readers. This prediction was based on the hypothesis that difference poor readers have adequate basic reading skills but need an organizational strategy. These results taken together with the work of Cromer (1970) provide a strong argument for difference poor readers' need for some form of organizational strategy in order for comprehension to be improved.

In summary, as with paired-associate learning research, there is evidence that there may be an interaction between ability and the degree to which an elaboration strategy is induced or imposed (refer again to Figure 1). Specifically, as reading ability increases, the elaboration procedure provided to the reader may need to be less imposed, and more induced. At the same time, poor readers seem to need experimenter-provided (imposed) elaboration in order for facilitation to occur.

When poor readers are further divided according to basic vocabulary skills, the ability to benefit from various degrees of elaboration is more finely isolated. Difference poor readers (poor reading ability but good vocabulary skills) have been found

to benefit from imagery instructions (induced) while deficit poor readers (poor reading ability and poor vocabulary skills) have not. The latter group, however, appears to benefit from a pictorial representation (imposed) of the text. A possible explanation has been provided to account for these findings: Difference poor readers have adequate reading skills, but lack an organizational strategy which is provided by the imagery strategy; deficit poor readers do not have adequate reading skills.

To further support this explanation, difference poor readers have been shown to benefit from text for which organization has been provided by the experimenter. This organization consisted of dividing the passage into meaningful phrase units.

Experimenter-Provided Questions

This review turns now to elaboration strategies which are verbal rather than pictorial. Just as pictorial strategies vary along a continuum from induced to imposed, so do verbal strategies. However, there has been little investigation into verbal elaboration strategies which are either primarily induced or primarily imposed; rather, most verbal elaboration strategies fall somewhere between the two. The bulk of this research generally using adults as subjects is concerned with experimenter-provided questions which are adjunct materials to the text passage. This technique is imposed in that the reader is presented with adjunct materials which require certain behavior (answering questions), but is also induced because the reader must construct his own elaboration by

generating proper responses to the questions.

Rothkopf (1972) considers techniques that control the processing activities of the reader to be of most importance in the learning of prose material since these activities determine what the effective stimuli in the passage will be. These effective stimuli are responsible for the internal representation of the material which in turn determines what is learned. In the Rothkopf (1972) paradigm, the processing activities of the reader are determined by environmental factors, the use of questions about the text, their placement in relation to the text, and the way they are asked. Frase (1970) considers questions to be directions that orient the reader to respond to certain parts of the text.

Rothkopf and Bisbicos (1967) have investigated the attention effect of questions in text. This effect has been demonstrated to be a function of the placement of the questions in the text. Periodic questions occurring just after the segment of text to which they refer result in more effective inspection behaviors. Specifically, they result in learning not only of relevant material but also of incidental material as well. The purpose of the study by Rothkopf and Bisbicos was to determine if the use of restricted categories of questions in text results in inspection behaviors which facilitate the learning of restricted categories of text content (e.g., items dealing with quantitative terms). The results confirmed expectations: Inspection behaviors were modified such that the subjects learned specific subsets of the experimental

material corresponding to the subsets referred to in the questions within the text.

Bull (1973) has explained how prequestions and postquestions differentially facilitate learning. Prequestions facilitate learning of material specific to the questions asked and inhibit learning of incidental material because they narrow the range of attention by providing the individual with a criterion for what material should be remembered. Postquestions facilitate learning of both question specific and incidental material because the reader pays attention to the whole passage, knowing that he will have to respond to specific questions but not knowing with which material those questions will be concerned.

Frase (1968), interested in the effect of questions on prose learning, compared prequestions and postquestions in aiding memory. By varying the amount of text between questions, while keeping the number of questions constant, the author was able to influence the type of material retained from the text. The advantage of the postquestions became larger the more frequent the questions. The disadvantage of prequestions was largest when questions occurred most frequently. Both relevant and incidental materials were adversely affected by frequent prequestions. The retention of incidental information was depressed with frequent postquestions; that is, as questions became more frequent, more relevant information was retained, but irrelevant information was retained less. This is in agreement with Ausubel (1963) who

distinguishes between a small-step approach for specific retention and a large-step approach for general retention.

Drawing in Response to Questions

The same general line of inquiry described above has been extended by Snowman and Cunningham (1975) to include subject-generated pictures which serve the same purpose as questions--devices to induce rehearsal or memory search. This elaborative strategy--calling for the subject to create the elaboration, while explicitly stating what parts of the text are to be elaborated--falls somewhere in the middle of the induced/imposed continuum of Figure 1. The authors reasoned that subject-generated pictures would be as effective as verbal responses because the reader would still have to make an overt response to a question, and such responses that are relevant to what is being learned should facilitate learning. This investigation gets support from Rohwer and Matz (1975) who stated that pictures requiring the same type of information processing as their semantic analogues may facilitate retention.

In Snowman and Cunningham's study with adults, subject-generated pictures were compared with experimenter-proveded multiple choice questions. Half of the posttest questions appeared throughout the text as either questions or directions to sketch a picture. These 20 posttest questions were classified as "relevant," in that they covered material that had already been referred to by the adjunct

questions or directions within the text. These questions or directions appeared either before or after the corresponding text. The remaining 20 posttest questions concerned material not referred to by the adjunct questions or directions, and were classified as "incidental."

Based on the results of the posttest, no difference in performance was found between the two types of adjunct aids--directions to draw were as good as questions. Furthermore, questions and drawing directions positioned after the text were more effective than when positioned before, and relevant questions were responded to more accurately than incidental questions. A significant interaction occurred between position of questions and directions (before or after) and relevant/incidental posttest questions. There was no position advantage with relevant material but questions and directions appearing after text segments produced increased retention of incidental items compared to questions and directions appearing before text segments. Discussion of this interaction by the authors in terms of different search strategies was the same as the explanation offered above by Bull (1973).

Research of this type provides a link between pictorial and verbal elaboration strategies and demonstrates how elaboration may be both induced and imposed. In the investigation by Snowman and Cunningham (1975), responses to specific questions were either pictorial or verbal and resulted in the same degree of facilitation. Both of these techniques lie somewhere on the continuum between

induced and imposed strategies--imposed in that the reader is provided with specific questions/directions to which he must respond, induced in that he generates his own answers or drawings. Directions to draw and instructions to image are similar in that both require the subject to generate a picture corresponding to the contents of the text. They are different in two ways: Instruction to image is a purely induced strategy, while direction to draw is both induced (subject-generated) and imposed (the subject looks at the product of his drawing). Secondly, imagery instructions appearing thus far in the literature have not directed the reader to generate specific images, but have allowed him to construct images that he considers appropriate for the text. Directions to draw have both allowed the subject to draw what he wishes and restricted the subject to drawing in response to specific questions.

In summary, the literature presented in this review is the result of crossing pictorial and verbal strategies with the induced/imposed continuum as presented in Figure 3. The strategies presented above occupy various positions in this diagram, not necessarily clearly contained within any one cell, but possibly overlapping cells. For example, imagery instructions would be an induced pictorial strategy, experimenter-provided illustrations would be an imposed pictorial strategy; while questions and instructions to draw pictures are verbal and pictorial strategies, respectively, which fall somewhere between induced and imposed.

Chapter III

STATEMENT OF THE PROBLEM

Although there have been comparisons made in previous prose research between pairs of the cells in Figure 2--e.g., imagery vs. illustration (Rasco et al., 1975); questions vs. illustrations (Snowman & Cunningham, 1975)--no attempt has been made to compare all four of the cells simultaneously to determine their relative effectivensss as reading comprehension strategies with children. This is in contrast to paired-associate research in which a comparison of all four strategies has been made by Kerst and Levin (1973). Similarly, only a few prose-learning studies (Heckler, 1975, Pressley, in press; Rohwer & Matz, 1975; Rohwer & Harris, 1975; and Levin, 1973) have compared the facilitative effects of elaboration techniques on different ability groups. The purpose of the present study was to add to this specific area to present subjects of different reading ability with a passage and one of the four elaboration strategies, measuring the facilitative effect of each technique.

The reading research cited above has used a narrow range of criterion passages made up of sentences that are similar in structure to verbal paired-associate elaboration and/or contain a strong story line. Examples of these types of materials include: "One type of monkey lives in banana trees. The bananas are very

good to eat..." (Rohwer & Matz, 1975); and "There once was a kingdom so small that it had only one road running from the border to the walls of the town. At this border was a green and white striped gate..." (Pressley, in press).

Recall that in the studies by Levin (1972b) and Levin et al. (in press) children's learning of information in discrete sentences was found to be facilitated by imagery instructions. It is therefore reasonable to expect increased performance in a reading task when imagery instructions are employed with passages containing sentences which resemble verbally elaborated paired associates, such as the passages by Rohwer and Matz (1975) and Pressley (in press) for which examples have been presented above.

A researcher interested in educational implications would like to know if elaboration procedures, such as imagery, can be successfully applied to school learning situations where the text material to be learned does more than tell a story, but teaches new concepts (such as the passages used in the research by Rasco, et al., 1975). For this reason, a passage was chosen for the present investigation which contained a number of new concepts which were not believed to be already known by the subjects.

Comparability of the Elaboration Strategies

In order to make a comparison among the four strategies (pictorial and verbal forms of induced and imposed elaboration),

it was necessary to modify some of the elaboration strategies so that their form was as parallel as possible within the constraints of each technique. Illustrations were considered to be the imposed counterpart of imagery, with the constraint that an illustration limits the information given to the reader, while complete control cannot be exerted on the content of the reader's imagery. An induced verbal condition consisted of requests to the reader to review verbally (i.e., to summarize) the portion of the text he had just read. This was assumed to be the verbal equivalent of the induced pictorial elaboration (imagery) strategy. In order to make the imposed verbal and pictorial strategies as comparable as possible, the imposed verbal strategy consisted of providing adjunct verbal statements which highlighted certain points of the text just as illustrations highlighted certain portions of the text. The resulting experimental strategies are depicted in Figure 4.

FIGURE 4

ELABORATION STRATEGIES USED IN THE EXPERIMENT

	Induced	Imposed
Pictorial	Instructions to Image	Experimenter-Provided Illustrations
Verbal	Instructions to Summarize	Experimenter-Provided Verbal Summaries

Given these four "parallel" forms of elaboration, certain comparisons were made to determine the relative effectiveness of each strategy in relation to a control condition in which no elaboration was provided or suggested by the experimenter. It was also of interest to determine if induced elaboration was more effective than imposed elaboration (within verbal and pictorial modes), and if pictorial was more effective than verbal elaboration (within imposed and induced forms). Furthermore, interactions between students' reading ability and conditions were analyzed to determine if subjects of different ability benefited more or less from certain elaboration strategies. Such comparisons were made separately for responses to questions pertaining only to illustrated/highlighted text, and for responses to questions pertaining to text which was not illustrated/highlighted (a replication and extension of Peeck, 1974, and Snowman & Cunningham, 1975).

Recall that Peeck compared questions pertaining to illustrated parts of the passage in the experimental condition with the same questions in the control condition, and also questions pertaining to unillustrated parts of the passage in the experimental condition with the same questions in the control condition. Although there was a trend in the direction of illustrations facilitating unillustrated text segments, there was no significant difference in retention for unillustrated text between the experimental and control conditions (but the difference was in the same direction

in three independent populations). In the present study, a comparison was made between these two performance profiles, i.e., for illustrated/highlighted and for unillustrated/nonhighlighted text. (The reason why no direct comparison of the two question types could be made will be discussed later.)

Predictions

Separate analyses were performed for responses to questions pertaining to text which was illustrated/highlighted, and for responses to questions pertaining to text which was not. Because of the nature of the four elaboration strategies, determination of the effectiveness of the elaboration procedures was based on either one or both of these. The analysis of responses pertaining to illustrated/highlighted text would demonstrate the facilitation of the imposed verbal and pictorial elaboration conditions. The analysis of responses to questions pertaining to text which was not illustrated/highlighted would demonstrate any facilitative side effect on this text as a result of imposed elaboration of the associated text. Since induced elaboration could be applied by the subjects to any portions of the text, the results of both analyses determined the effectiveness of the induced verbal and pictorial strategies. These analyses were used to test the following hypotheses based on the rationale presented above.

The evidence based on paired-associate learning (e.g., Kerst & Levin, 1973) and reading research (e.g., Rohwer & Matz,

1975; Lesgold, Levin et al., 1975) has shown that providing children with suitable elaborative strategies facilitates memory compared to when children are left to their own devices. Research using questions placed throughout the text (e.g., Rothkopf & Bisbicos, 1967) has demonstrated consistent facilitation of memory for text with adults. The first and second hypotheses tested in the present study were based directly on the research using pictorial elaboration with text, as well as extensions of the verbal facilitation findings in paired-associate learning and questions research.

Hypothesis 1. For questions pertaining to elaborated text, performance would be improved in each of the experimental conditions relative to control.

Hypothesis 2. For questions pertaining to text which was not elaborated, performance would be improved in the induced verbal and pictorial conditions relative to control.

Research involving the use of questions positioned throughout the text has consistently demonstrated that questions not only facilitate memory for the text to which they refer, but also for text not explicitly referred to by the questions (e.g., Rothkopf & Bisbicos, 1967; Snowman & Cunningham, 1975). Research using pictures to illustrate text has suggested a similar finding: Memory for text which is not explicitly highlighted by an illustration may also be facilitated (Peeck, 1974). This research prompted the third hypothesis:

Hypothesis 3. For questions pertaining to text which was not elaborated, performance would be improved in the imposed verbal and pictorial conditions relative to the control.

The work of Rohwer and his associates (e.g., Rohwer et al., 1967) and Levin (e.g., Levin, 1973) has shown that high ability children are less in need of elaborative strategies than are low ability children; and therefore, high ability children do not benefit as much from the strategies in paired-associate learning or memory for text. The fourth hypothesis was based on this research:

Hypothesis 4. Students who are below grade level reading ability would benefit more than students above grade level reading ability from the elaboration strategies.

Furthermore, comparisons were performed which were of interest to the present investigation but for which no specific predictions could be made. These were comparisons between induced and imposed elaboration (within pictorial and within verbal), and pictorial and verbal (within induced and within imposed).

Chapter IV

METHOD AND PROCEDURES

Subjects

The subjects consisted of 192 fifth grade children from two schools: one in southeastern Wisconsin serving a middle-class suburban population, and one serving a rural community in southeastern Wisconsin.

Fifth graders were chosen as subjects in the present investigation for a number of reasons: First, most research with a focus similar to that of this study has used children of about this age (for example, Peeck, 1974, presented illustrations to fourth graders; Kulhavy & Swenson, 1975 instructed fifth and sixth graders to form images); second, children of this age seem able to comply with imagery instructions without extensive training (Kulhavy & Swenson, 1975; Levin, 1973); third, fifth graders are less likely than adults to apply effective learning strategies, such as imagery in the absence of explicit instructions (recall the study by Anderson and Kulhavy, 1972, in which adult subjects reported imaging in a non-strategy control).[6]

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[6] Levin and Divine-Hawkins (1974) have shown that even with fifth graders there is a disposition on the part of some children toward utilization of a strategy even when not instructed to do so. Even though these authors found facilitation due to imagery instructions, of the 50 children who reported frequent use of imagery, 20 of them were in the uninstructed control condition.

The subjects were identified as being in one of two reading ability categories, based on comprehension subtests from standardized tests administered to intact classrooms by the schools (the Iowa Test of Basic Skills for subjects in one school and the Metropolitan Readiness Test for subjects in the other). Subjects were classified so that approximately half of the children were designated as above grade level readers and the remaining half were designated as at or below grade level readers.

In order to include subjects from both schools in the same analysis, it was necessary to use common criteria for assigning subjects in both schools to the appropriate reader categories. Since different standardized tests were used by the two schools, equivalency tables contained in the Anchor Test Study (1974) were used to convert one set of scores to the other.[7]

Materials

A passage of 490 words in length contained in seven paragraphs was used to assess the effects of the experimental manipulations. This passage was taken from a social studies textbook intended for sixth grade level (Social Science, 1970). This passage describes

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[7]The Anchor Test Study was initially conducted to permit the analysis of scores on various reading achievement tests. Scores on different standardized tests are not numerically comparable because of variations in standardization procedures among the tests. The equivalency tables contained in this study may be used to convert scores obtained on one test to equivalent scores on another.

the effect of the industrial revolution on cloth production. As can be seen from Appendix A, the passage refers to social, cultural, and economic changes during the seventeenth century. A second passage, used for warmup, was taken from the children's story Winnie-the-Pooh (Milne, 1926), and consisted of 465 words also in seven paragraphs. This passage, unlike the first passage, has a very noticeable story line (see Appendix A). Being familiar to most children, it may have served to decrease anxiety about the text situation. The passages were chosen because it was possible to illustrate their contents with simple line drawings.

The associated illustrations and verbal highlights which were used in the imposed pictorial and verbal conditions are presented in Appendix A. Each illustration and verbal highlight corresponds to one paragraph of each passage. These adjunct materials were constructed so as to provide approximately the same information in verbal and pictorial form corresponding to each paragraph.

Norming Study. The illustrations were constructed through the cooperative effort of the experimenter and three artists. The two passages were obtained based on the agreement by these four people that they could be illustrated. Then, the best possible way to illustrate each paragraph was discussed followed by preliminary sketches by one of the artists. Only when all four people agreed that an illustration was the best possible for the paragraph was it retained and a final drawing made. All illustrations were presented in color because it was believed that color would make

them more comprehensible.

To accomplish comparability between illustrations and verbal highlights, five adults (including the experimenter) were given the two passages and corresponding illustrations and asked to generate one sentence per paragraph that corresponded to the associated illustration. They were informed of the nature of the task and the population for which the materials were intended. They were also cautioned not to include more information in their verbal statement than was contained in the illustration.

These verbal statements (five for each paragraph, except when duplicate statements were generated) were shuffled and presented along with the illustrations alone to a separate group of 20 adults. These adults were told to choose the verbal statement that best agreed with the illustration. There was popular opinion for one statement over the others in all but a few cases. When the majority was split between two statements, it was because there were only small wording differences between the statements. The statements which were chosen most were used as adjunct aids in the imposed verbal condition.

Main Study. The passages were presented one paragraph per page with each of the paragraphs on the left side of the page with the corresponding adjunct aid (illustration or verbal summary) on the right side. This was done so that the subjects in the imposed conditions could look back and fourth between passage and adjunct aid if they so chose.

Materials for the induced pictorial and verbal conditions were constructed in a manner similar to the materials used in the imposed conditions. On the right hand side of each page was either the word SENTENCE or PICTURE which were reminders to the subjects to think of in their own words what the paragraph was about (S-generated verbal summary) or get a picture in their mind of what the paragraph was about (Image)--see Appendix A.

The posttest questions were short-answer fill-in-the-blank, and consisted of two questions for each paragraph. One of each of these two questions pertained to text which was illustrated or verbally highlighted, while the remaining question pertained to some other points in the paragraph. To determine what points of the passage should form the basis of this second group of questions, the main points of each paragraph, which were not referred to in the illustration or verbal statement, were listed and one was randomly sleected for each paragraph. It is important to point out here that because of the procedure used to generate the portions of text that were illustrated/highlighted and those that were not, no direct comparison of the two question types was made. Rather, comparisons among conditions were performed within each question type separately. All 28 questions were of the "What," "Why," or "How" variety (see Appendix B).

Procedure

In addition to the two passages on which the subjects were

instructed to execute the various strategies, two other passages were also presented. These other passages (taken from the Wisconsin Design for Reading Skills Development (1974) were to aid in the determination of the three reading abilities (good, difference poor, and deficit poor) originally intended to be a factor in the present investigation. After reading each of these two passages, short-answer questions were asked. These stories were short (about 100 words), and reading them and answering the questions took only about seven minutes. This section of the study will not be considered further because it did not provide any usable information.

Each subject was individually presented with all four passages; the third and fourth passages were presented under one of the experimental conditions. Subjects were allowed to read at their own rate; their reading time was recorded by the experimenter and found to vary between approximately two and seven minutes (most subjects read each passage in about four minutes) for the warmup and criterion passages. Though not explicitly recorded on a per-subject basis, it was clear that subjects in the induced conditions took the longest time.

In the control condition, subjects were instructed to read the passage carefully because later they were expected to answer questions about the passage contents (see Appendix C for detailed instructions for all conditions). Subjects in the four experimental conditions were also told that they would be tested on the passage contents.

In the imagery condition, subjects were instructed to read each passage carefully, and after reading each paragraph, when they saw the word PICTURE, they were to pause and get a picture in their mind of what the paragraph was about. Two additional procedures were employed to increase the probability of imagery production: First, these subjects were informed that they would be expected to reproduce their images by drawing from memory at the end of the session (in fact, the experimenter asked each subject to describe one of his images from each test passage after the posttest); second, these subjects were also told that when they were imaging, they should look up for a few seconds so that the experimenter would have some indication that they might be imaging. An example was provided of what was meant by getting a picture in their mind corresponding to a passage.

In the subject-generated verbal summary condition, subjects were instructed to read each paragraph carefully, and after reading each paragraph, when they saw the word SENTENCE, they were to pause and, in their own words, think of what the paragraph was about. The same two additional procedures were used here as in the imagery condition--namely that subjects would be expected to reproduce their verbal summary (they were asked to reproduce one of these after the posttest), and that they should look up for a few seconds. An example was provided of what their verbal summary might be.

In the illustration condition, subjects were instructed to read the passage carefully and after reading each paragraph, they

should look at the accompanying illustration which would be a reminder to them of what the paragraph was about.

In the experimenter-provided verbal statement condition, subjects were instructed to read the passage carefully and after reading each paragraph, they should look at the accompanying verbal statement which would be a reminder to them of what the paragraph was about.

The same verbal and pictorial examples that were used in the induced conditions were also used in the imposed verbal and pictorial conditions. As was stated previously, the Pooh passage was used as a warmup because its character was familiar to the subjects. Each test was given immediately after each passage (the warmup passage and the criterion passage) was read. The experimenter read the questions and the subject verbalized the responses which were recorded by the experimenter. After the questions were asked for the warmup passage, the subject was instructed to read the second passage.

Design

Two sets of analyses were performed on the data. One set involved responses to questions which were elaborated; the other set involved responses to questions which were not elaborated. Each set of analyses consisted of comparisons between each of the treatments and the control, as well as comparisons among certain treatments. These contrasts were performed on the data as arranged

in Figure 4. Only specific analyses of this 2 x 5 array were of interest in the present investigation. These are presented in Figure 5.

FIGURE 5

ARRANGEMENT OF THE DATA FOR EACH SET OF ANALYSES

Reading Ability	Control	Instructions To Image	Experimenter-Provided Illustrations	Instructions To Summarize	Experimenter-Provided Verbal Summaries
Above Grade Level					
At or Below Grade Level					

Within each type of question, the first eight contrasts were used to compare each treatment with the control across reading ability, as well as the interaction between treatment and ability (e.g., the first contrast compared Instructions to Image with Control across reading ability; the second contrast compared the interaction of reading ability with the Imagery-Control difference). The second eight contrasts were used to compare treatments with each other. Of the six possible comparisons between treatments (and the corresponding six interaction comparisons) only four were

FIGURE 6

CONTRASTS USED TO COMPARE THE CELLS OF FIGURE 5

Comparison		Reading Ability: At or Below Average					Reading Ability: Above Average				
		Control	Image	Illustration	S-Summary	E-Summary	Control	Image	Illustration	S-Summary	E-Summary
Control vs. Instructions to Image	ψ_1	+1	-1				+1	-1			
	ψ_2	+1	-1				-1	+1			
Control vs. Experimenter-Provided Illustrations	ψ_3	+1		-1			+1		-1		
	ψ_4	+1		-1			-1		+1		
Control vs. Instructions to Summarize	ψ_5	+1			-1		+1			-1	
	ψ_6	+1			-1		-1			+1	
Control vs. Experimenter-Provided Summary	ψ_7	+1				-1	+1				-1
	ψ_8	+1				-1	-1				+1
Instructions to Image vs. Experimenter-Provided Illustration	ψ_9		+1	-1				+1	-1		
	ψ_{10}		+1	-1				-1	+1		
Instructions to Image vs. Instructions to Summarize	ψ_{11}		+1		-1			+1		-1	
	ψ_{12}		+1		-1			-1		+1	
Experimenter-Provided Illustration vs. Experimenter Provided Summary	ψ_{13}			+1		-1			+1		-1
	ψ_{14}			+1		-1			-1		+1
Instructions to Summarize vs. Experimenter-Provided Summary	ψ_{15}				+1	-1				+1	-1
	ψ_{16}				+1	-1				-1	+1

of interest in the present investigation. These contrasts compared induced vs. imposed (within pictorial and within verbal), and pictorial vs. verbal (within induced and within imposed). The corresponding interaction contrasts compared the relative facilitation of the treatments for each reader type (e.g., the ninth contrast compared Instructions to Image and Illustrations across reading ability with the Imagery-Illustration difference). The four contrasts comparing a treatment with the Control across reading ability were directional (one-tailed), the remaining 12 contrasts were not (two-tailed). Each comparison was tested at an alpha-level of .0125.

Following Levin (1975), it was determined that with 20 subjects per condition, power would be .70 to detect a .65σ difference between any treatment and the control condition (α = .0125, one-tailed). Similarly, with this number of subjects, power was .70 to detect a .70σ difference associated with each of the remaining contrasts (α = .0125, two-tailed). An alpha level of .0125 for each comparison was chosen so as to keep the experiment-wise error rate within reasonable limits (16 tests on each of 2 question types, with α = .0125 for each, yields an experiment-wise error rate of .40).

CHAPTER V

RESULTS

The effect of treatments and their differential facilitation for the two ability groups was determined through two sets of analyses; one set of analyses of responses to questions pertaining to text which was elaborated, and another set of analyses of responses to questions pertaining to text which was not elaborated. The results of this investigation will be presented by first considering the first set of analyses followed by a consideration of the second set of analyses. As each comparison of a set of analyses (between two treatments, or between a treatment and the control) is considered, the corresponding interaction involving the two ability groups will also be considered.

Analyses of Questions Corresponding to Elaborated Text

Sixteen planned comparisons as presented in Figure 5 were performed to determine facilitation due to treatments and differential effects as a function of ability level for responses to questions pertaining to text which was elaborated. Each comparison was tested at an α-level of .0125. The four comparisons between the control and each treatment were directional; the remaining 12 were not.

Since subjects were randomly assigned to treatments prior to

determination of their ability group placement, and because some subjects were dropped from the study because there were no standard achievement reading scores available for them, the resulting sample sizes were unequal from one ability/treatment combination to the next (see Table I). As a result, it was necessary to compute the harmonic mean of the cell sizes (N = 19.9641) which was then used in unweighted means analyses (see Kirk, 1968).

To facilitate the reader's interpretation of the data, they have been converted to percentages. The error term for questions which referred to elaborated text was computed to be $MS_E = 421.45$. This term was used in each of the 16 comparisons. The standard deviations from which this term was calculated are presented in Table I.

The mean percentages of correct responses (out of seven) are also presented in Table I. Analyses consisted of planned comparisons among these cell means. Each comparison was between four cells (two conditions by the two ability groups) for main effect of treatment, and the interaction between treatment and ability. There were eight comparisons of a treatment with the control (four main effects and four interactions), and eight comparisons (four main effects and four interactions) between treatments. These comparisons and their corresponding F-ratios are presented in Table II. The values of F necessary to obtain significance at $\alpha = .0125$ with 1 and 190 degrees of freedom is

TABLE I

CELL SIZES, MEAN PERCENT CORRECT, AND STANDARD DEVIATIONS FOR EACH ABILITY LEVEL AND TREATMENT

	Control	Instructions to Image	Experimenter-Provided Illustration	Instructions to Summarize	Experimenter-Provided Summary
At or Below Grade Level	n = 21 $\bar{X}$ = 32.65 SD = 21.26	25 40.00 14.87	21 44.22 22.54	18 28.57 21.91	20 36.43 15.70
Above Grade Level	n = 21 $\bar{X}$ = 52.38 SD = 27.97	16 38.39 20.68	20 62.14 18.70	20 44.29 14.58	20 64.29 23.86
Across Grade Levels (Unweighted Mean)	42.52	39.2	53.18	36.43	50.36

$\tilde{n}$ = 19.9641

MS_E = 29.50

TABLE II

COMPARISONS AND CORRESPONDING F-RATIOS FOR QUESTIONS PERTAINING TO ELABORATED TEXT

Comparison	F-Ratio	
	Main Effect	Interaction
Control vs Instructions to Image	<1	5.3909
Control vs Experimenter-Provided Illustration	5.3858*	<1
Control vs Instructions to Summarize	1.7560	<1
Control vs Experimenter-Provided Summary	2.9116	<1
Instructions to Image vs Experimenter Provided Illustration	9.2627*	4.5191
Instructions to Image vs Instructions to Summarize	<1	3.5531
Experimenter-Provided Illustration vs Experimenter-Provided Summary	<1	1.1681
Instructions to Summarize vs Experimenter-Provided Summary	9.1901*	1.7462

*significant at $\alpha = .01$

5.10 for the directional comparisons and 6.25 for the non-directional comparisons.

The first four main effect comparisons presented in Table II were conducted to test Hypothesis 1. As can be seen, there is only one of these four comparisons which supports the hypothesis; namely, Experimenter-provided illustrations compared to the Control. There was no facilitation as a function of the other three treatments. In fact, Instructions to Summarize descriptively decreased performance compared to the Control.

The corresponding interactions showed no significant differential facilitation of treatments compared to the Control for the two ability groups. The interaction between ability and the Imagery-Control differences which approached significance was due to a slight increase in performance for the low ability group, and a corresponding decrease in performance for the high ability group in the Imagery condition relative to the Control.

Of the remaining eight comparisons (between treatments), two main effect contrasts were significant: induced vs. imposed within pictorial; induced vs. imposed within verbal. For both of these comparisons, experimenter-provided elaboration was better than subject-generated elaboration. The interaction between ability and the first of these differences (imposed-induced within pictorial) approached significance. This was primarily due to the higher performance of the above grade level group in the illustration condition compared to their performance in the Imagery

condition. However, as was noted previously with reference to the Control condition, this is not so much a function of the facilitative effect of Illustrations as it is a function of the depressed performance under Imagery instructions.

Analyses of Questions Corresponding to Unelaborated Text

Sixteen planned comparisons as presented in Figure 5 were performed to determine facilitation due to treatments and differential effects according to ability level for responses to questions pertaining to text which was not elaborated. Each comparison was tested at an α-level of .0125; the four comparisons between the control and one treatment were directional, the remaining 12 were not.

The error term for questions which referred to unelaborated text was computed to be $MS_E = 381.51$ in each of the 16 comparisons. The standard deviations from which this term were calculated are presented in Table III. The mean percentages of correct responses (out of seven) are also presented in Table III. Analysis consisted of planned comparisons among these cell means. The 16 comparisons for these analyses were based on the same contrasts as the questions pertaining to elaborated text. These comparisons and their corresponding *F*-ratios are presented in Table IV. The values of *F* necessary to obtain significance at $\alpha = .0125$ (1 and 190 *df*) are 5.10 (directional) and 6.25 (non-directional).

TABLE III

CELL SIZES, MEAN PERCENT CORRECT, AND STANDARD DEVIATIONS FOR EACH ABILITY LEVEL AND TREATMENT

	Control	Instructions to Image	Experimenter-Provided Illustration	Instructions to Summarize	Experimenter-Provided Summary
At or Below Grade Level	n = 21 $\bar{X}$ = 18.37 SD = 17.58	25 19.43 17.92	21 18.37 20.27	18 17.46 21.11	20 12.14 14.11
Above Grade Level	n = 21 $\bar{X}$ = 33.33 SD = 19.34	16 24.11 23.97	20 29.29 18.47	20 34.29 18.19	20 35.71 25.60
Across Grade Levels (Unweighted Means)	25.85	21.77	28.83	25.88	23.93

$\tilde{n}$ = 19.9641

MS_E = 27.27

TABLE IV

COMPARISONS AND CORRESPONDING F-RATIOS FOR QUESTIONS PERTAINING TO UNELABORATED TEXT

Comparison	F-Ratio	
	Main Effect	Interaction
Control vs Instructions to Image	<1	1.356
Control vs Experimenter-Provided Illustration	<1	<1
Control vs Instructions to Summarize	<1	<1
Control vs Experimenter-Provided Summary	<1	<1
Instructions to Image vs Experimenter-Provided Illustration	2.5537	3.3794
Instructions to Image vs Instructions to Summarize	<1	1.8907
Experimenter-Provided Illustration vs Experimenter-Provided Summary	<1	<1
Instructions to Summarize vs Experimenter-Provided Summary	<1	<1

This set of comparisons was conducted to test Hypotheses 2 and 3. As can be seen, there are no significant differences associated with any of these contrasts. There was no facilitation for text to which these questions referred.

Summary of Analyses as Related to Previous Hypotheses

The first and second hypotheses predicted that there would be facilitation in the induced verbal and pictorial conditions for all text because there could be no control over what portions of the text the subject would choose to elaborate when induced to do so. Analysis of both types of questions showed that no facilitation occurred as a function of the two induced strategies.

The third hypothesis predicted that there may be facilitation in the imposed verbal and pictorial conditions for text which was not elaborated because of its association with the elaborated text. This was not demonstrated, but the lack of facilitation for unelaborated text may have been due to the small amount of facilitation for the elaborated text.

Although no specific predictions were made based on the two ability groups, it was expected that the low ability group would benefit more from provided illustrations than would the high ability group. This was not found to be the case. In fact, both groups benefited from illustrations by about the same amount compared to the Control.

Chapter VI

DISCUSSION

This study was designed and conducted to answer two general questions: Can elaboration strategies which have been shown to work with laboratory passages be as effective with more school-like (referred to here as "textbook") passages? Can verbal elaboration procedures be shown to facilitate memory for text as effectively as pictorial elaboration? Attempting to answer both of these questions in one study may have resulted in compromising the accuracy with which each question was answered. Specifically, since the elaboration procedures used in the present study provided only marginal facilitation with the type of passage used, a legitimate comparison of verbal and pictorial strategies may have been undermined.

In this discussion some additional research will be presented of which, during the time when the present study was being designed and conducted, this author was not aware. These studies have investigated pictorial and verbal elaboration strategies using textbook passages. This research will be followed by the work of Levin, Bender and Lesgold (in press) who suggest a more reasonable control procedure against which to compare elaborative strategies using adjunct aids such as pictures and verbal statements.

Then, the results of the present investigation will be discussed,

considering first the analysis of responses to questions pertaining to elaborated text, then the analysis of responses to questions pertaining to unelaborated text. Following this, supplementary results will be presented in which college students were subjected to the procedures used in the present investigation. In view of these results, some comments concerning the difficulty of the passage will be considered.

Finally, implications of the present research and suggestions for future research will be discussed. As stated above, the current investigation has created more questions than it has answered.

Additional Research Using Textbook Passages and Verbal Elaboration

At the outset of this study, the present author was not aware of research which might provide some idea of what to expect with a textbook passage and verbal elaboration. The studies by Gibbons and Boutwell (1972) and by Rasco, Tennyson, and Boutwell (1975) contained so many apparent discrepancies and flaws that their findings are highly suspect. For instance, the authors appear to have incorrectly reported a significant imagery effect while in fact inspection of the data suggests that illustrations yielded significant facilitation. As it turns out, the findings of the present study are in close agreement with the findings of these two investigations--that recall of textbook passages is not improved with imagery instructions but some improvement

is obtained by providing illustrations.

During the writing of this paper, two additional sources of information became known which bear substantially on the predictions and findings of this investigation. One is a paper presented by Lesgold and Curtis (1974); the other is Curtis' master's thesis (1975). In these studies, verbal elaboration was investigated and then compared with imagery instructions using textbook passages.

The first of these investigations, by Lesgold and Curtis (1974), compared instructions to college students to prepare verbal summaries while reading passages (and then write out the summary) with a control group instructed to read the passages for recall (and then alphabetize the words in each passage). A third group was instructed to prepare summaries, but they wrote the summaries for only half of the passages, and alphabetized the other half of the passages. This last group was included to determine if writing the summaries was the important activity or if preparing the summary was sufficient. The results were that both treatments were significantly different from the control but not from one another. No comparison was made in the third group between performance on passages for which summaries were written, and passages which were alphabetized by the subjects. Moreover, when the subjects were divided into good and poor readers based on a standard reading comprehension test, no interaction was found between ability and treatment; both groups benefited equally from the strategy.

Apparently, preparation of a verbal summary is sufficient to improve performance.

Although a significant difference was found between treatments and control, interpretation of these findings is necessary. The control group used in this study did more than just read for recall--they filled time by alphabetizing the words in the passage. Intuitively, this control procedure should have no detrimental effect on recall compared to a control merely instructed to read for recall. But in a subsequent study, Curtis found a marked decrease in performance when control subjects alphabetized the passage in comparison to when they simply read for recall.

Curtis (in preparation) compared verbal and pictorial strategies with read-plus-alphabetize and read-only control groups. The strategies were made parallel by requiring adult subjects in the pictorial elaboration group to draw a series of illustrations depicting the contents of the passage, while subjects in the verbal elaboration group wrote summaries of the passage. These subjects and those in the read-plus-alphabetize group actually performed significantly poorer than the read-only control.

This finding limits the interpretation of results that compare elaboration treatments with control conditions (e.g., Lesgold & Curtis, 1974). Although Lesgold and Curtis obtained facilitation from their treatments compared to a control, these results must be tempered by the results of the Curtis study; namely that the control used by Lesgold and Curtis (alphabetizing the passage) actually

depresses performance compared to only reading the passage.

Levin, Bender, and Lesgold (in press) further tested this possibility by requiring one control group of young children to color geometric shapes while another control group only read. There was no difference in recall between these two groups.

Why should a time-filling activity (alphabetizing the passage or coloring geometric shapes) produce different results in these studies? It may be that while coloring geometric shapes only fills time, alphabetizing the passage creates confusion in the readers. While searching through the passage for words that begin in a certain letter, the reader may be scrambling the passage in his memory. This alphabetizing may therefore interfere with what has been read, while coloring shapes does not.

It must be kept in mind that the studies by Lesgold and Curtis used adult subjects, while the study by Levin, Bender, and Lesgold used young children; and that this difference limits any comparison that can be made between the studies. It cannot be assumed that procedures that result in certain behaviors with adults will result in similar behaviors with children. In fact, Levin, Bender, and Lesgold initially discounted the possibility that simple repetition would be an effective strategy for children based on evidence demonstrating that simple rehearsal was not effective for adults. Therefore, while alphabetizing may lead to interference with adults, it may not for children. One possible explanation for this could be that adults, because of their over-learned reading skills, are

unable to process the first letter of a word without processing the entire word; while such would not be the case for children who are just learning the skills required for reading.

The work of Lesgold, McCormick and Golinkoff (1975) is also relevant here. Recall that these researchers compared imagery facilitation for story-like passages and a standard reading achievement test (MAT reading subtest). When reminded to use the imagery strategy, recall was improved for the story-like passage. However, even when these third and fourth graders were reminded to generate images during the MAT, there was no facilitation due to imagery instructions. These findings may have been due to the two different types of passages (text-book vs. story), or as the authors suggested, the imagery training procedures may have been ineffective in a standard reading test where the apparently important factors are word recognition, sentence understanding, and test-taking skills. These skills are in contrast with the emphasis of the training procedure which stressed attending to the main passage themes.

An additional point should be mentioned here. In this study by Lesgold, McCormick, and Golinkoff, the story-like passages were administered on an individual basis, while the MAT was administered to classroom groups. Perhaps the individual attention was responsible for the imagery facilitation. In such a one-to-one setting, there may be a greater likelihood of subjects' compliance with instructions.

Considering the combined research efforts of Lesgold and Curtis; Curtis; Lesgold, McCormick and Golinkoff; Gibbons and

Boutwell; and Rasco, Tennyson, and Boutwell, what predictions could have been made? When measuring recall for text-like passages, previous research has consistently demonstrated that induced pictorial and verbal elaboration provide no facilitation while illustration does. These results compare favorably with the findings of the present investigation. Each of these findings will now be considered in turn with the hope of shedding more light on this body of research.

Results of the Present Investigation

The results will be discussed according to their presentation in the previous chapter. This discussion will first deal with responses to questions pertaining to elaborated and then to unelaborated text. Following this, there will be a general discussion of the findings of this and similar research, and the implications of these findings including suggestions for further research.

Responses to questions pertaining to elaborated text. Of the significant comparisons in this investigation, all involved this group of questions. The first of these, a comparison of control with illustrations, has been consistently supported in recent reading research; not only where the passages have been specially constructed for the task (e.g., Guttmann, 1976; Rohwer & Matz, 1975; Lesgold, McCormick, & Golinkoff, 1975; Shimron, 1974, with oral presentation), but also when passages were taken from textbooks (Gibbons & Boutwell,

1972; Rasco, Tennyson, & Boutwell, 1975) and children's stories (Peeck, 1974). Illustrations used in this capacity probably aid recall by representing the material in a second mode, and by supplying some organization which combines the components of the passage. That this method of elaboration has been repeatedly shown to be facilitative for text recall is probably due to the lack of interpretation required by the reader to comprehend the stimuli.[8] In all the other strategies, the reader is required to obtain information from printed text. Surely, this body of research has firmly established the facilitative effect of illustrations on comprehension--especially that of children--something that Samuels (1970) attempted to discount.

A possible alternative explanation of the facilitative effects of illustrations on text suggested by Lesgold, Levin, et al. (1975) is that illustrations merely provide a second rehearsal of the passage. If this is the case, providing illustrations with text is not very appealing because of the difficulty in creating illustrations in comparison with simply instructing subjects to read the text a second time. This possibility has been tested directly by Levin, Bender, and Lesgold (in press).

In one experiment by Levin, Bender, and Lesgold, first graders listened to three short passages (five sentences each) under one of

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[8] According to Elkind (see Footnote 1), by age 11 children have learned to comprehend the theme of an illustration that requires some inference on the part of the child.

five conditions. Three of the conditions were variations of providing cut-outs and a background, which when combined, illustrated the text. These treatments were compared with a repetition condition in which the subject repeated each sentence as it was presented; and a control in which subjects simply listened. Results showed that the four treatments were equally facilitative and significantly better than the control. These findings suggested that providing illustrations may be no better than simple verbal rehearsal.

This possibility was investigated further in a second experiment. Because of the possibility of a ceiling effect in the first experiment, Bender and Levin used longer passages (Guttmann's two 10-sentence passages) in an attempt to amplify any difference that might exist between rehearsal and illustration. The results of this study demonstrated that while rehearsal was significantly better than control, providing illustrations was significantly better than rehearsal. These findings suggest that there is increased facilitation when illustrations are provided relative to simple verbal repetition. Illustrations may provide more than a second rehearsal making their use as a text-learning aid justifiable.

There are implications of these findings to the present study and other studies of similar design where adjunct materials are used to facilitate recall. If performance in a reading task can be considerably improved by requiring the reader simply to repeat what has been read or heard, then any other strategy requiring

elaborate techniques should result in performance that is considerably better than simple repetition, or else there is not sufficient payoff to warrant the elaborate technique. In other words, it seems crucial that the effectiveness of elaborative strategies be measured in reference to a simple repetition strategy.

A contributor to the second significant finding in the present study, the significant difference between Imagery and Illustration, was the large drop in performance of the above-average readers in the Imagery condition relative to the Control (a difference in mean performance of 14%). However, the interactions involving ability and the difference between the two treatments (Imagery and Illustration), as well as ability and the difference between each treatment with the control were not found to be statistically significant. This may be attributable to the difficulty of the passage. As mentioned before, the illustrations supplied information contained in the text but did not require that it be abstracted from the text. In this regard, the illustrations can be viewed as an adjunct aid that could be used instead of the text. On the other hand, subjects in the Imagery conditions first had to process the prose and then form an image based on it. Given that the passage used turned out to be quite difficult, this task may not have been easily accomplished. This is similar to the problem encountered by Deficit-poor readers (those with word decoding problems) with simple passages in the study by Levin (1973). Those findings of decreased performance in the Imagery condition are consistent with

the results of Lesgold and Curtis (1974) and Curtis (in preparation) discussed above in which induced elaboration decreased performance relative to a read-only control. However, these findings are inconsistent with the results of a number of studies by Levin, Lesgold and others in which imagery instructions are facilitative (especially for listening tasks) when the passage is specifically constructed for the task. These discrepant findings related to the type of passage will continue to emerge in this discussion and will be considered more thoroughly below.

The significant difference between induced and imposed elaboration in the pictorial mode was also demonstrated in the verbal mode. In the comparison between Subject-generated and Experimenter-provided verbal summaries, the improvement in performance from induced to imposed was consistent for both reading ability groups. Both groups benefited more from an imposed verbal strategy. This tendency for the imposed strategies to be more facilitative than the induced strategies is in spite of the fact that subjects in the induced conditions took noticeably longer to complete the task.

The same argument is offered here as was offered above for the pictorial mode: Perhaps the passage difficulty prevented the children from benefiting from an induced strategy because they first had to process the prose and then generate a suitable verbal summary of it. On the other hand, the experimenter-provided verbal summary could stand by itself in place of the text. The

main points of the passage could be obtained from the summaries which were short and simpler than the paragraphs to which they related, making processing an easier task. And again, these findings are consistent with those of Lesgold and Curtis (1974): Induced strategies are of no benefit when the passage is difficult.

In line with the model depicted in Figure 1, it is appropriate to comment at this point that the ability to elaborate a passage depends on the difficulty of the passage and the ability of the reader. As passage difficulty increases, elaboration becomes more difficult; as subject ability increases, readers become more able to provide their own elaboration, relying less on elaboration provided by the experimenter. In fact, it seems reasonable to assume that there is an interaction between subject ability and task difficulty such that as ability increases, more difficult passages may be successfully elaborated by the subject. What may be too difficult a passage for fifth graders to elaborate, may be sufficiently easy for adult readers to elaborate.

At this point, one can only speculate about why such passages do not lend themselves to facilitation by induced elaboration. It has been pointed out elsewhere in this paper that passages constructed specifically for reading research, such as those discussed above, consist of extensions of verbally elaborated paired-associates which are typically very concrete and imageable. Furthermore, there is typically a strong story line throughout the passage, little information of an instructional nature is transmitted,

and the contents are more concrete and comprehensible. This is in contrast with textbook passages which are intended to convey new knowledge. Seldom is there a story line which continues through the passage, and the sentences are generally of more complex construction. One or all of these factors may be responsible for the lack of facilitation found in the present study.

Beyond the predictions of facilitation due to the strategies, additional comparisons involving main effects and interactions were of interest, but for which there were no specific predictions, or were post hoc. The first of these was an interest in determining whether verbal or pictorial elaboration would be more facilitative. A considerable amoung of research which was presented above has shown that at least with certain types of passages pictorial elaboration is effective. Little research has been concerned with verbal elaboration in reading research so that its facilitative effect is uncertain.

The present study and the work of Lesgold and Curtis (1974) suggests that verbal and pictorial strategies are comparable at least with a textbook passage. Whether this finding will hold up with passages specifically constructed for the test remains to be seen. For that matter, the present finding suggesting comparability between verbal and pictorial elaboration modes might be tested with additional (less difficult) textbook passages.

A second aim of the present study was to investigate interactions between the various strategies and reading ability. Based

on the discussion relating to the induced/imposed continuum that was presented earlier (Figure 1), it was anticipated that below-average readers would benefit more from imposed elaboration than from induced elaboration. This finding was not statistically supported in the present study; no significant interaction comparisons were obtained between ability and induced and imposed strategies. However, inspection of the data reveals that there was a tendency for both ability groups to benefit more from the imposed strategies than from the induced strategies. This descriptive finding is in agreement with the discussion presented above: Namely that as difficulty increases, elaboration must be more imposed in order to be facilitative.

Responses to questions pertaining to unelaborated text. There were no significant differences associated with any of the eight comparisons made for these questions. Analysis of these comparisons was conducted to test Hypotheses 2 and 3. The induced strategies should have had the same effect for all the text because there was no control over what segments of the text would be elaborated by the subjects. As in the analyses of responses pertaining to elaborated text, there was no facilitation for responses pertaining to unelaborated text in the induced strategy conditions.

Hypothesis 3 was not supported at all by these data. The trend in the data obtained by Peeck (consistent, but non-significant facilitation for unelaborated text) suggested that because of its association with elaborated text, recall for unelaborated text may

be improved. Failure to support this prediction may be due to the fact that such facilitation does not occur, or the difficulty of the passage prevented this finding from being observed (below average readers got only 17% of these questions correct, and above-average readers got only 33% correct). A third alternative explanation may be the way in which the questions were selected. Questions for the unelaborated text were based on portions of text that may be considered peripheral to the main ideas of the passage.

Supplementary Results

The overall low level of performance deserves some comment. The highest average level of responding was 52% for the above-grade level readers on the elaborated text questions (36% for the below-grade level readers). This low performance suggests that the passage was of considerable difficulty for the fifth grade subjects. In fact, data were subsequently collected on a group of college students. The same passages and elaboration strategies were administered to a group of about 35 students. The mean performance for these subjects averaged over all questions and conditions was about 70%. So although the passage was taken from a commonly used sixth grade text, it was quite difficult and may have depressed performance to such a low level that differences among treatments were concealed.

The results of this supplementary experiment warrant comment. There were only a few subjects in each condition (an average of 7)

so that the results were not analyzed statistically, but it is worth pointing out that the means were 71% for Control, 64% for Imagery, 70% for Illustrations, 64% for Subject-generated summaries, and 59% for Experimenter-provided summaries. This narrow spread of scores suggests that subjects were not able to benefit from the strategies. In fact, all treatments yielded performance below the control condition, a finding similar to that obtained by Curtis (in preparation). For adult readers, these low levels of performance are especially surprising. It would be expected that adults would have some familiarity with the passage contents, thus increasing their correct response rate. They should also have been able to comprehend the text because the concepts should not be new to college students.

Difficulty of the Passage

Why should such a passage, intended for a sixth grade audience, be so difficult even for adults? Apparently, social studies (and science) textbooks, because of the nature of the subject matter, are typically written at least two grade levels above the grade level for which they are intended.[9] This procedure is not intentional, and has only recently been recognized. The high level of reading difficulty is not obviously apparent, for it exists

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[9]Personal communication from Dr. Kay Harty, principal of Midvale School, Madison, Wisconsin, November 1975.

not in the surface structure but in the deep semantic structure. There is currently an attempt to remedy this situation. Text aimed directly at a fifth grade level of comprehension would be a desirable stimulus passage for the present investigation.

There is one other fact concerning passage difficulty: The control condition performance (for the main study) for unelaborated text questions was 33% for above-grade level readers, and 18% for below-grade level readers. The control condition performance for elaborated text questions was 52% and 33%. These levels of performance suggest that there was a considerable difference in difficulty between the text which was elaborated and the text which was not. This no doubt reflects the way in which the text was divided into elaborated and unelaborated segments. Recall that the requirements for selection of elaborated text was that it could be illustrated. This suggests that these portions of text were more concrete and could stand alone from the context of the passage. These factors may have been the reason why the elaborated text was easier to learn than the unelaborated text.

Implications of this Research

The purpose of this study was to determine if strategies could be identified which would aid in increasing children's reading performance on school-related text materials. The strategies chosen have been repeatedly demonstrated to be either highly successful or related to highly successful procedures used in the laboratory

with specially designed passages. If these strategies could be adapted to text-like material, the implications to classroom learning are obvious. Unfortunately, the treatments selected for the present study were not very successful.

Should the results of this research suggest that there is no reward in further investigation of the practical application of elaboration strategies? Certainly not; there is enough support from this study and other research cited in Chapter 2 to suggest that there are factors involved in facilitative reading strategies about which the scientist is not yet aware. If the strategies work for certain passages, what prevents them from not facilitating memory and comprehension for other passages? The demonstration that illustrations facilitated performance in this investigation is quite significant in and of itself. After all, that the placement of pictures can improve performance makes it an important candidate for inclusion into text materials. If such a simple treatment can have significant effects on recall, it might be used more in textbooks instead of just in early readers and children's stories. Furthermore, the use of adjunct illustrations might prove to be especially useful for children who are considered disadvantaged or in remedial programs--children whose reading problems might be based on the inability to obtain meaning from printed materials. Such children would be able to comprehend meaning through adjunct illustrations and therefore begin to acquire new knowledge.

Of course, these children would probably obtain the most information from the combined oral plus pictorial presentation which has been the subject of a number of studies referred to above. But the use of printed text augmented with illustrations might provide the greatest facilitation in aiding such children to begin to comprehend printed text by allowing the child to compare the information presented in the illustrations with the information contained in the text. However, such a procedure would have to be employed with great caution, since the possibility would exist that the child would bypass the text and rely solely on the information contained in the illustration.

The fact that subject-generated elaboration works very well on simple passages, while only illustrations benefited recall here, may suggest that different strategies should be utilized for materials of different difficulty. For instance, subject-generated strategies could be taught to students so that they could use them with stories and other easy materials, while illustrations could be provided when the text is more difficult.

Suggestions for Future Research

The results of the present study have generated more questions than have been answered. Although there was only marginal success obtained through elaboration strategies in this study, the same or similar techniques have been highly successful in other investigations. To deal with this discrepancy, it might be necessary to

determine the ways in which the passages used across different studies vary. Control over passage content, structure, and difficulty will probably enable researchers to predict the sort of passage for which various types of elaboration will be successful. But this line of research will provide answers to only some of the questions asked in the present study.

The choice of elaboration procedures used in the present investigation was quite arbitrary even though they were designed to provide maximum comparability in the analyses. For instance, although great care went into the construction of the verbal statements to insure that they were "parallel" to their corresponding illustrations, additional procedures might have been more effective. The verbal statements provided by the experimenter were generated and normed by adults who, although they were told to create the statements for a fifth grade audience, may have used syntactic constructions which were too difficult for fifth graders. It may have been more appropriate to request other fifth graders to generate the verbal statements.

The subject-generated verbal strategy condition also could have been modified in such a way to be more suitable. Perhaps the request to generate a "summary" was not a suitable verbal elaboration instruction. A procedure which may be more appropriate would be to instruct the reader to question himself concerning what he has read. Preparation to test this treatment is currently being considered.

A further modification of the present investigation would involve a within-subjects design, but only with the imposed strategies. In such a procedure, subjects would be presented with illustrations of some portions of the text and verbal statements corresponding to other portions, while some text would not be elaborated. This design would permit a within-subjects comparison of the verbal and pictorial imposed strategies, while at the same time, determining any facilitative effect for unelaborated text. Such a design would not be feasible for the induced strategies because of the possibility of establishing competing mind sets. After complying with imagery instructions, it may be unreasonable to switch over to verbalization instructions, ignoring the previous imagery set.

To deal with the other main focus of this research--Do verbal and pictorial stragegies provide comparable facilitation?--a second study should be conducted in the same way as the present study but with different kinds of passages. For instance, a passage could be selected and pilot-tested with excellent fifth-grade readers to determine its comprehensibility. Once this was established, the passage could be used in the same (or similar) procedures used in the present investigation.

An alternate method would be to select a passage similar to those used by Rohwer, Levin, etc. In particular, Pressley's (in press) highly concrete narrative passage appears to provide a very desirable point of departure. The degree of facilitation

provided by imagery instructions and illustrations for passages of this kind is well documented, so that at the outset it will be known that pictorial elaboration will work. Parallel verbal strategies could then be compared to determine their degrees of facilitation. This first step in determination of comparability between the verbal and pictorial modes could then set the way for further research. For example: Are different types of passages facilitated more by one or the other mode of elaboration? Do children of different ability type respond more favorably to one mode of elaboration (verbal or pictorial) than the other? There have already been some investigations into this area, the results of which strongly suggest that some children do exhibit a preference for one mode over the other.

In one of these studies (Mallory, 1972), children from kindergarten and second grade were presented with a mixed paired-associate list in which items were presented in one of three ways: (a) side-by-side pictures accompanied by an orally-presented sentence which described an interaction between the pictured items (verbal elaboration), (b) pictures in an interaction accompanied by their verbal labels (pictorial elaboration), (c) side-by-side pictures accompanied by their verbal labels (control). Based on performance on this list, subjects who performed best under pictorial elaboration were designated visualizers; subjects who performed best under verbal elaboration were designated as verbalizers. These subjects were subsequently presented with homogeneous lists of pictures either pictorially or

verbally elaborated. Consistent with expectations, verbalizers performed better on auditory-elaboration items than did visualizers, and visualizers performed better on pictorial-elaboration items than did verbalizers.

This investigation was extended by Levin, Divine-Hawkins, Kerst, and Guttmann (1974) to a comparison between learner types in two different (though related) tasks: paired-associate learning and reading comprehension. Based on a mixed list, half of which was pictures and half words, fourth graders were designated as being good or poor picture and/or word learners. Following this, the subjects were tested on a reading comprehension task in which half were instructed to read only, and half were instructed to image. Of those instructed to read only, there was no significant difference between the groups, while for the imagery instruction condition, the subjects who were good picture learners (and either good or poor word learners) significantly outperformed poor picture learners. A worthwhile investigation in this area would be to extend the Levin et al. (1974) study to include all of the elaboration strategies used in the current investigation. Such an experiment would determine the facilitation of both verbal strategies for good word learners, as well as the facilitation of illustrations for good picture learners.

One further potential line of inquiry would be to determine if subject-generated elaboration works best for one type of reader, while experimenter-provided elaboration works best for another type

of reader. Recall that Levin (1973) has already dmonstrated one facet of this question: Poor readers with good vocabulary skills benefit from imagery instructions (induced) more than poor readers with poor vocabulary skills; while the latter group appears to benefit more from a pictorial presentation (imposed) of the passage than does the former. Further research is needed to determine the facilitative effect of pictorial augmentation in contrast with pictorial representation), as well as the differential facilitative effects of induced and imposed verbal elaboration for different ability groups. The line of inquiry could provide a direct test of the model depicted in Figure 1 in which it is assumed that low ability readers would benefit more from experimenter-provided than from subject-generated elaboration.

This line of research would also enable us to determine the facilitative effects of imposed elaboration on peripheral text (text which is not elaborated). If it can be determined that illustrations or summaries of portions of the text facilitate recall of the rest of the text, then future research can determine the ratio of elaborated to unelaborated text sufficient for facilitation to occur in the same way that research on questions placement on text has been investigated by Frase, Rothkopf, and their associates.

Finally, if these lines of inquiry are successful (that is, if elaboration proves to be successful in practical reading situations), programs could focus on ways in which such techniques could be implemented into the classroom curriculum. What could be

more appropriate than teaching children ways of improving their memory and comprehension? Such a step should be undertaken with caution as Davidson (1970) has so persuasively argued. But the argument should not discourage us from trying such a venture if it seems feasible. Such a program might encompass both imposed and induced components: textbook modifications in which illustrations and summaries could serve to elaborate the text on the one hand; and assistance to children in developing their own elaborative strategies on the other.

Chapter VII

SUMMARY

Recent research into reading comprehension has demonstrated that subjects' memory for what they read can be enhanced using verbal and pictorial elaboration. The basis for these investigations comes from associative-learning research in which the connection between pairs of pictures or words is facilitated by providing suitable elaborative learning strategies. Support for the facilitative effects of verbal and pictorial elaboration is provided by Kerst and Levin (1973) in which nine and ten year olds were instructed either to look at, or generate pictures or sentences depicting interactions between pairs of pictures. Performance was facilitated by the elaborative strategies, with no difference between strategies except that there was greater variability among the subject-generated strategies suggesting to the authors that there exists greater individual differences in the ability to generate facilitative elaboration in comparison to simply using provided elaboration.

The extension of these learning strategies to the investigation of their effects on reading comprehension has been concerned mainly with pictorial elaboration which is subject-generated (imagery) and experimenter-provided (illustrations). Extending the results of Kerst and Levin (1973) from associative learning to reading comprehension, Levin (1973) demonstrated that children

who had good vocabulary skills, but poor reading comprehension, benefited from imagery instructions, while children with poor vocabulary and reading comprehension skills tended to benefit from experimenter-provided illustrations.

Verbal elaboration applied to reading comprehension has not developed out of associative-learning research but, rather, has been a separate area of investigation primarily into the effects of questions placed within the body of text. Rothkopf and Bisbicos (1967), for example, have shown that periodic questions occurring just after the segment of text to which they refer result in learning not only of material referred to by the questions, but also of materials not referred to by the questions.

The present study was an attempt to extend the results of Kerst and Levin's (1973) subject-generated and experimenter-provided verbal and pictorial elaboration, as well as Levin's (1973) investigation of the differential facilitation due to reader differences. Fifth graders read a social studies textbook passage under one of four experimental conditions (subject-generated or experimenter-provided, verbal or pictorial, elaboration) or control. After data collection, subjects were divided into above or below average ability readers (based on standardized reading comprehension tests). The prediction was that below average readers would benefit most from the elaborative strategies--especially imposed pictures, where reading demands are reduced--

and that above-average readers might or might not benefit from the experimental treatments.

For the E-Picture condition, a main point of each paragraph was illustrated by a line drawing. For the E-Verbal condition, sentences were constructed that corresponded to each of the illustrations. Each passage was presented with one paragraph on the left side of a page along with either its corresponding illustration or verbal statement to the right. In the two conditions in which subjects were to provide their own elaboration (S-Picture and S-Verbal), either the word PICTURE or SENTENCE appeared on the right side of the page. Fourteen short-answer "Wh" questions were generated for each passage: seven corresponding to elaborated text (that is, corresponding to text that was explicitly illustrated), seven corresponding to the remainder of the text.

The words SENTENCE or PICTURE were cues to the subjects respectively either to think of in their own words what the paragraph was about, or to get a picture in their mind corresponding to what the paragraph was about. Subjects in the two experimenter-provided elaboration conditions were told to look carefully at either the verbal statement or the illustration because they would be reminders of what the paragraph was about. All subjects were told that they would be tested after reading the paragraph and that the elaboration would help them remember the story. Subjects were tested individually in a separate room at the school.

Based on scores obtained from standardized tests, group-administered by the schools (Iowa Test of Basic Skills, and the Metropolitan Achievement Test), subjects were divided into two groups--above and below grade level (which was 5.5).

For responses to both sets of questions--those pertaining to text which was elaborated, and those pertaining to text which was not elaborated--planned comparisons were performed to determine facilitation due to treatments and differential effects related to ability level. No analysis was performed comparing directly these two groups of questions because of the non-random manner in which they were constructed.

Analysis of Elaborated Text Questions

For the main effect comparisons between treatments and control, there was only one comparison which was significant--Σ-Pictures compared to the control. This finding has been consistently supported by research; not only where passages have been specially constructed for the task (e.g., Rohwer & Matz, 1975; Lesgold, McCromick, & Golinkoff, 1975), but also when passages were taken from textbooks (Gibbons & Boutwell, 1972; Rasco, Tennyson, & Boutwell, 1975), and children's stories (Peeck, 1974).

In addition to the interest in the effects due to treatments, it was also expected that there would be an interaction between treatment and ability: The low ability group would benefit more from provided illustrations than would the high ability group.

This was not found to be the case. In fact, both groups benefited from illustrations by about the same amount compared to the Control. Furthermore, two main effect contrasts showed that E-Provided elaboration was significantly more facilitative than S-Generated elaboration: E-Picture versus S-Picture; E-Verbal versus S-Verbal. If we consider the difficulty of the passage used in this study, this finding is in agreement with the predicted relationship between ability and task difficulty; namely, that as difficulty increases relative to ability, elaboration must be more imposed in order to be facilitative.

Analysis of Unelaborated Text Questions

Of the planned comparisons for questions corresponding to unelaborated text, none were significant. There was no facilitation for text to which these questions referred. Failure to obtain facilitation for unelaborated text may be due to the fact that such facilitation (through association with elaborated text) does not occur with the elaboration strategies used in the present investigation (in contrast to facilitation found in adjunct questions research), or the difficulty of the passage prevented this finding from being observed. A third alternative explanation may be the way in which the questions were selected: Questions for the unelaborated text were based on portions of text that may be considered peripheral to the main ideas of the passage.

Future research in this area should examine the same (and

similar) elaborative strategies with different types of passages that may be more conducive to the experimental procedure. Such passages may be less difficult, be of the storybook variety, or be specially constructed for the task so as to maximize the opportunity to evaluate and compare the various strategies. Furthermore, an attempt could be made to select groups of children whose ability level is considerably more disparate, thereby enhancing the expected differential facilitation for the two groups. Finally, other modes of individual differences could be investigated under this task, such as the differential ability to benefit more from verbal or pictorial elaboration.

APPENDIX A

TEST MATERIALS

THE INDUSTRIAL REVOLUTION

a. Text

b. Adjunct Materials

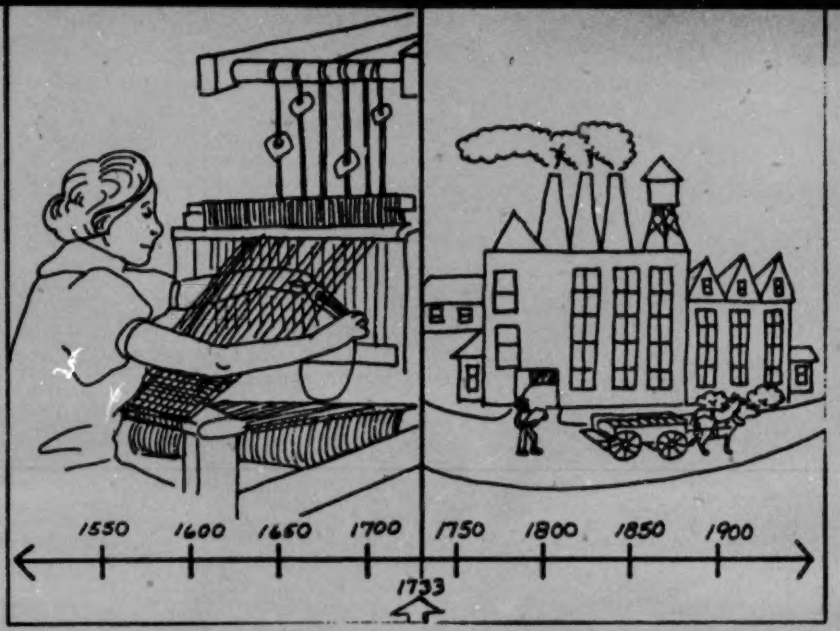
WINNIE-THE-POOH

a. Text

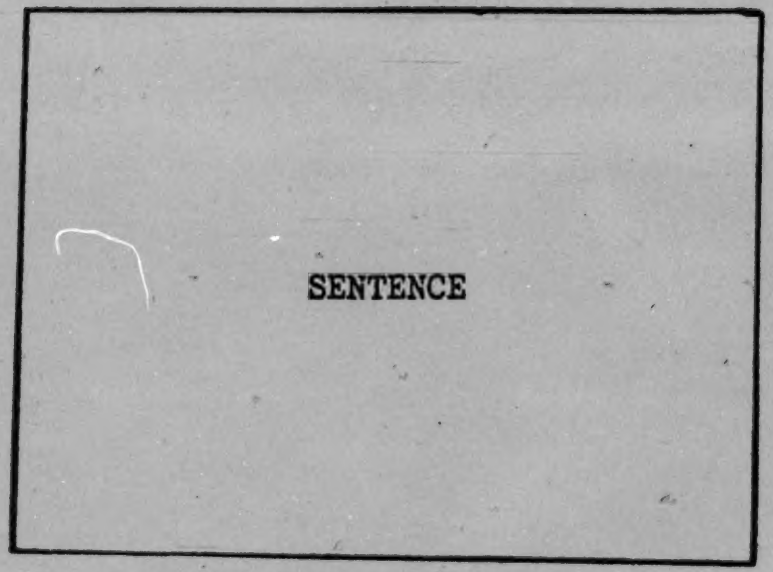
b. Adjunct Materials

THE INDUSTRIAL REVOLUTION

The Industrial Revolution in 1733 brought great changes in the ways goods were produced. These changes came most quickly and most strikingly in the cloth industry. First, cloth making moved from the home to the factory. Second, cotton cloth took the place of wool as the most important textile product of Britain.



After 1733, clothing making changed from being made by hand to being made in the factory.



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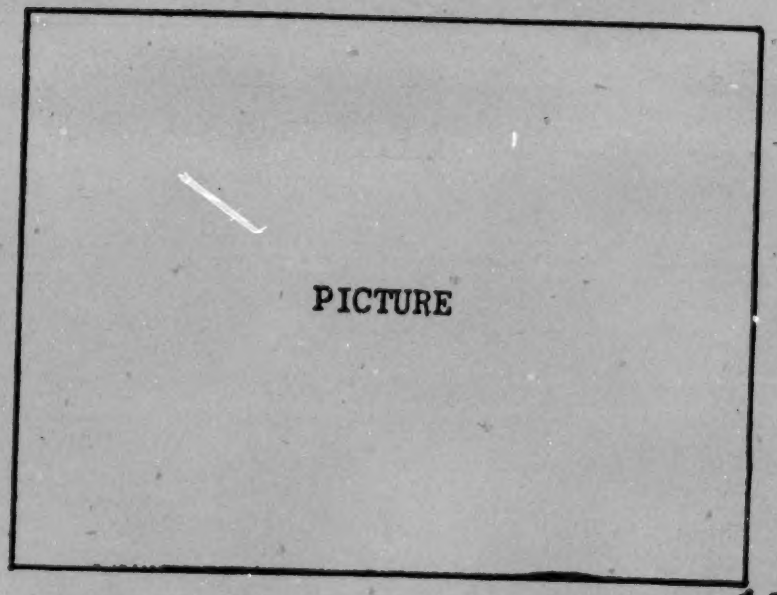

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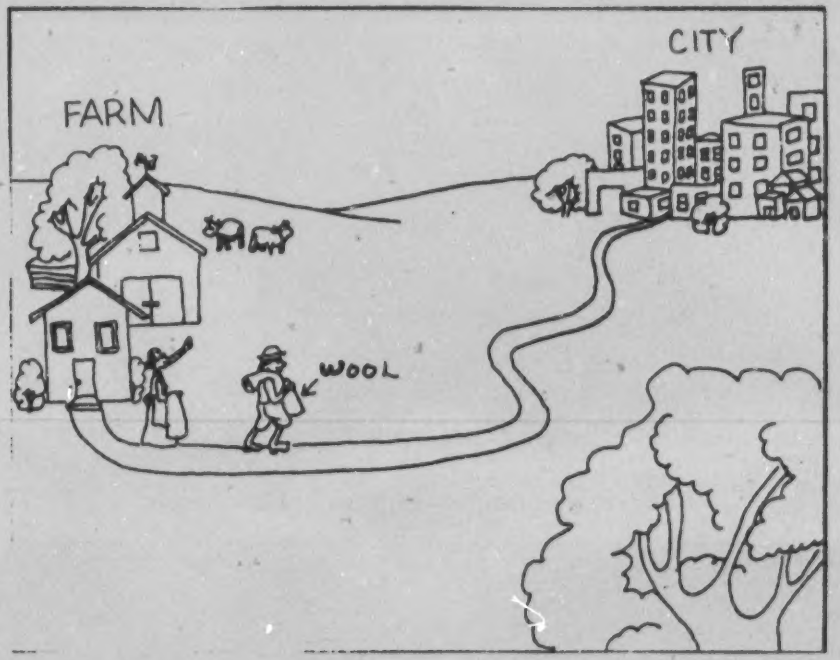
In the seventeenth century, most Europeans wore clothing made of wool. Cotton was expensive and hard to get. This was because most of the cotton cloth used in Britain was imported from India. Still, those who could afford it liked clothing made of Indian cotton. As the demand for cotton increased, a cotton cloth industry began to grow in Britain. After 1700, more raw cotton became available. The American colonies in the South began to grow large amounts of cotton, using slaves as labor. This, in turn, spurred the growth of the British cotton industry.

People preferred cotton clothing over wool clothing.

At first, cotton workers used the traditional methods and machines of the wool makers. Wool cloth had been made all over Britain for centuries. The thread was spun and woven into cloth in many homes by the entire family. On market day, the farmer took the finished cloth to the nearest town to sell it. Wool cloth was an important part of most farmers' income.

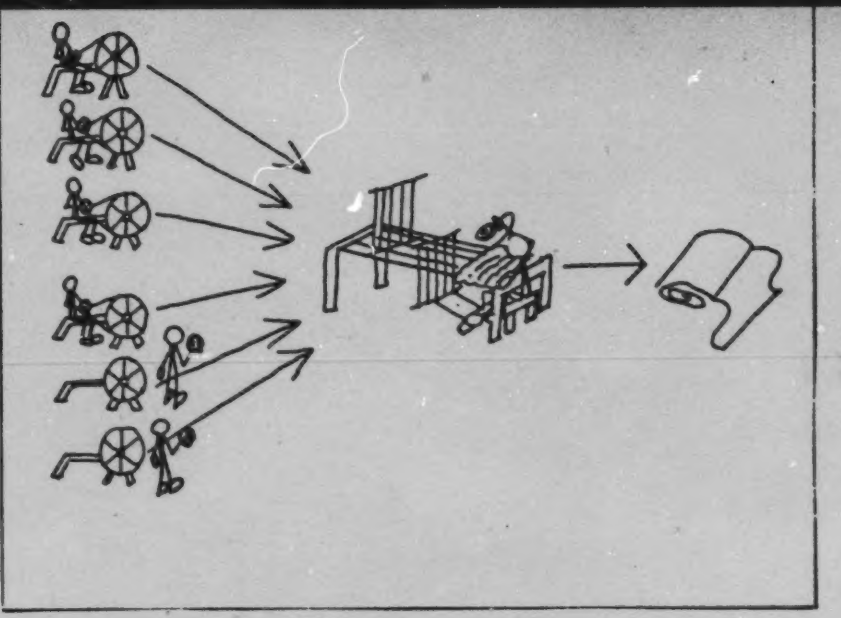
135



The farmer took the wool cloth to the city.

136

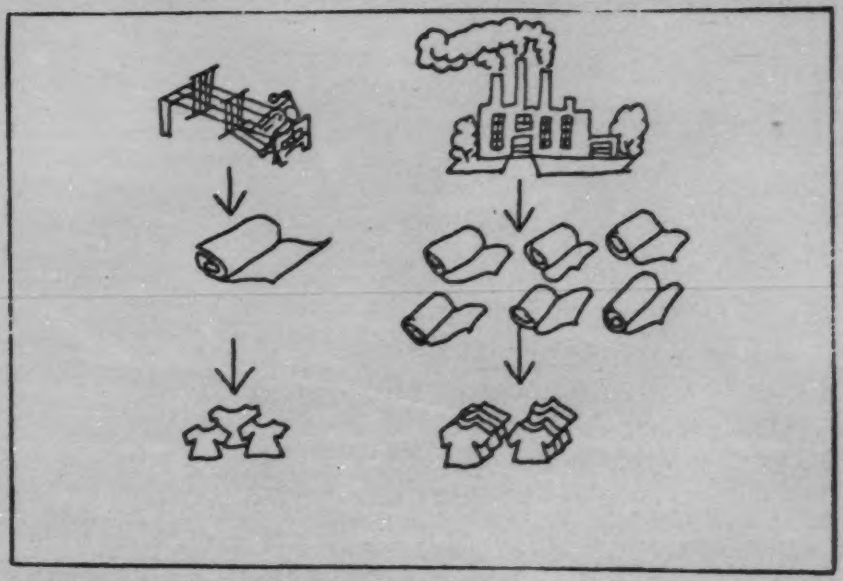
Not all cloth making was done by individual families. Spinning was a very slow process. It took about six spinners to produce enough yarn to keep one weaver busy. In the villages, a weaver often bought a large amount of raw wool from neighboring farmers. Then he went from house to house in the village distributing the wool to spinners. In return, he paid the spinners a small wage.



It takes six spinners to produce enough yarn for a weaver to make cloth.

Traditional methods were used for making cotton cloth, too. Then a series of inventions made it possible for more cotton to be produced faster than ever before. The first of these was a simple but important improvement in the loom. Before we read about this improvement, let us review the traditional weaving method.

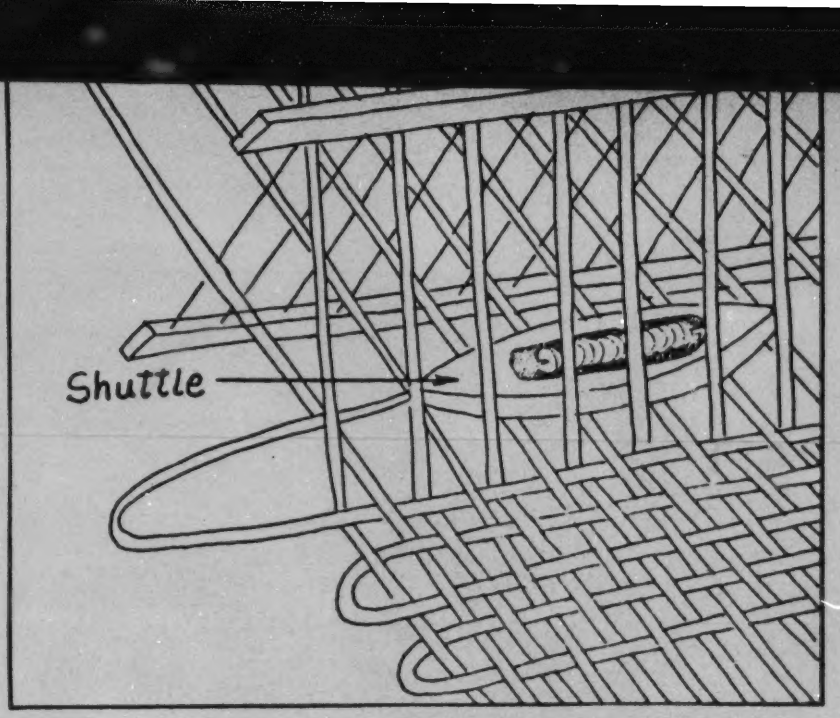
139



Cloth was produced faster by factory loom than by hand loom.

140

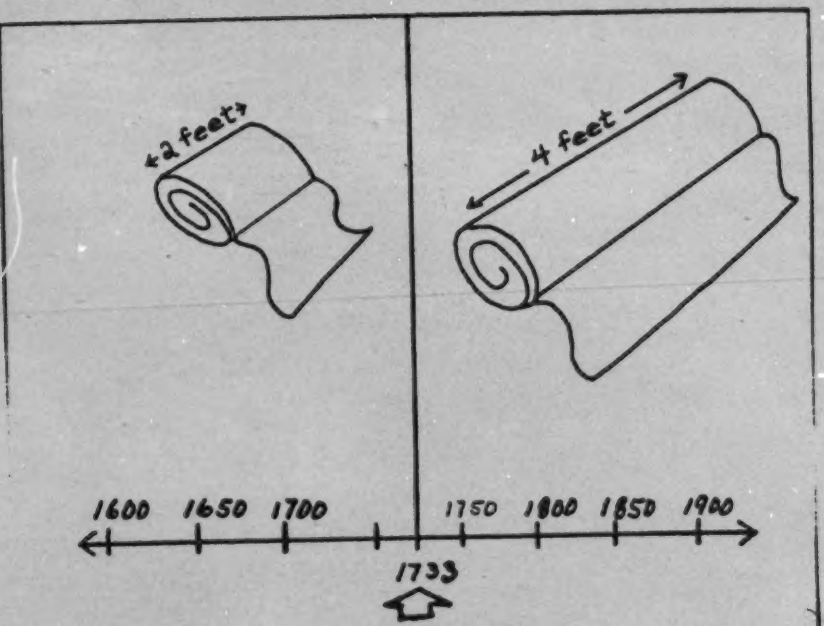
Length-wise threads, called the warp, were placed on the loom. Even-numbered warp threads were raised by pressing a foot pedal. Another foot pedal raised the odd-numbered threads. The shuttle was a needle-shaped piece of wood, with a spool of yarn inside it. It was passed over and under the warp threads, leaving cross-wise threads, called the woof.



On a loom, crosswise threads from a shuttle were passed over and under the lengthwise threads.

In 1733, John Kay, a weaver, mechanic, and clockmaker, invented a new kind of shuttle, called a flying shuttle. The weaver no longer had to pass the shuttle back and forth by hand. A weaver using a flying shuttle could weave a very wide piece of cloth rapidly. Gradually, flying-shuttle looms took the place of the old hand looms in cottages and workshops throughout England. However, weavers did not like Kay's invention at the time. They rioted and broke into his house, destroying everything in it. Kay was forced to flee to France.

143



After 1733, wider cloth was produced.

144

WINNIE-THE-POOH

Once upon a time, a very long time ago now, about last Friday, Winnie-the-Pooh lived in a forest all by himself under the name of Sanders.

146

Winnie-the-Pooh was sitting in front of his house in the forest.

147

126

One day when he was out walking, he came to an open place in the middle of the forest, and in the middle of this place was a large oak-tree, and, from the top of the tree, there came a loud buzzing-noise.

When walking in the woods,
Pooh heard a buzzing-noise
in the trees.

Winnie-the-Pooh sat down at the foot of the tree, put his head between his paws and began to think. First of all he said to himself: "That buzzing-noise means something. You don't get a buzzing-noise like that, just buzzing and buzzing, without its meaning something. If there's a buzzing-noise, somebody's making a buzzing-noise, and the only reason for making a buzzing-noise that I know of is because you're a bee."

150

Pooh saw that the buzzing sound was being made by bees.

151

Then he thought another long time, and said: "And the only reason for being a bee that I know of is making honey." And then he got up, and said: "And the only reason for making honey is so as I can eat it." So he began to climb the tree.

Pooh thought about honey.

He climbed and he climbed and he climbed, and as he climbed he sang a little song to himself. It went like this:

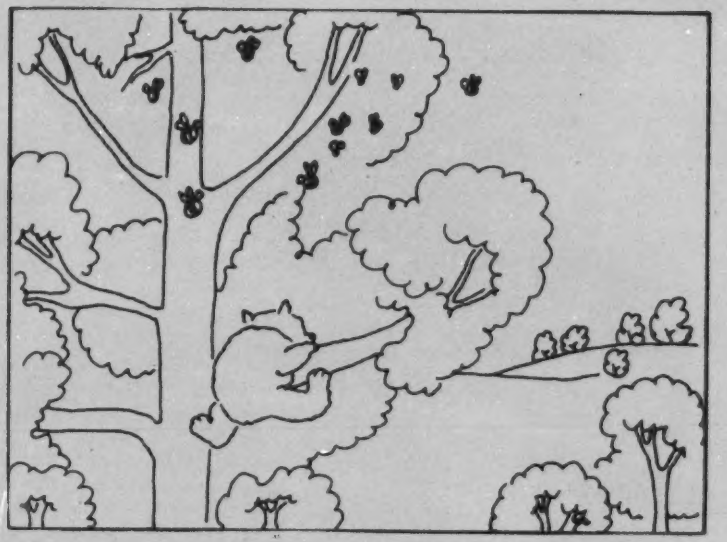
Isn't it funny
How a bear likes honey?
Buzz! Buzz! Buzz! Buzz!
I wonder why he does?

Then he climbed a little further . . . and a little further . . . and then just a little further. By that time he had thought of another song.

It's a very funny thought that, if Bears were Bees,
They'd build their nests at the bottom of trees.
And that being so (if the Bees were Bears),
We shouldn't have to climb up all these stairs.

He was getting rather tired by this time, so that is why he sang a Complaining Song.

154



Pooh climbed the tree towards the bees.

155

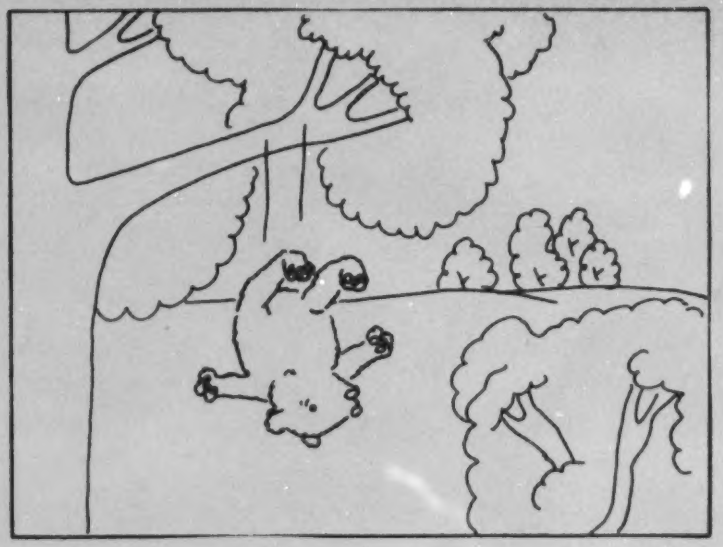
He was nearly there now; and if he just stood on that branch . . . Crack!

"Oh, help!" said Pooh, as he dropped ten feet on the branch below him.

"If only I hadn't----" he said, as he bounced twenty feet on to the next branch.

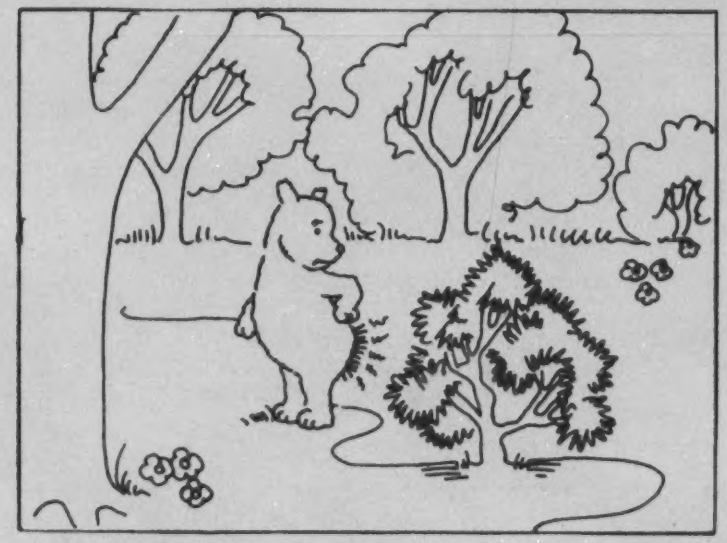
"You see, what I meant to do," he explained, as he turned head-over-heels, and crashed on to another branch thirty feet below, "what I meant to do----"

"Of course, it was rather----" he admitted, as he slithered very quickly through the next six branches.



Pooh fell out of the tree.

"It all comes, I suppose," he decided, as he said good-bye to the last branch, spun round three times, and flew gracefully into a thorn bush," it all comes of liking honey so much. Oh, help!" He crawled out of the thorn bush, brushed the prickles from his nose, and began to think again. And the first person he thought of was Christopher Robin.



Pooh landed in a thorn bush.

APPENDIX B

TEST QUESTIONS FOR:
THE INDUSTRIAL REVOLUTION
WINNIE-THE-POOH

THE INDUSTRIAL REVOLUTION

1. What was produced differently after the Industrial Revolution in 1733? _____

2. Where did cloth making move to from the home? _____

3. What type of clothing did people prefer most? _____

4. Where did large amounts of cotton come from? _____

5. Where did farmers take their wool cloth to sell? _____

6. Who spun and wove wool into cloth in the British homes? _____

7. Who bought raw wool from the farmers? _____

8. How many spinners were necessary to keep one weaver busy? _____

9. What did the change from hand looms to factory looms do to the production of cloth? _____

10. What was the first thing that was improved to increase the speed of cloth production? _____

11. What passes over and under the threads of the loom to produce the crosswise weave of the cloth? _____

12. How are the threads of the loom raised and lowered? _____

13. After the Industrial Revolution in 1733, what was different about the cloth that was produced? _____

14. What didn't have to be done by hand with the flying shuttle? _____

WINNIE-THE-POOH

1. What was Winnie-the-Pooh's last name? _____
2. Where was Pooh's house? _____
3. What sound did Pooh hear in the treetops? _____
4. What was in the middle of the open place in the forest? _____
5. What did Pooh do when he sat down and put his head between his paws? _____
6. What was making the buzzing noise? _____
7. What did the bees remind Pooh of? _____
8. According to Pooh, what was the only reason for making honey? _____
9. If bears were bees, where would they build their nests? _____
10. What did Pooh do to get to the honey? _____
11. What happened when Pooh was nearly to the top of the tree? _____
12. While he was falling, what did Pooh think about the idea of climbing the tree? _____
13. Where did Pooh finally land? _____
14. Who did Pooh think of when he got out of the thorn bush? _____

APPENDIX C

ELABORATION INSTRUCTIONS

CONTROL

I want you to read some stories. The first one is about Winnie-the-Pooh. Read the story carefully because when you finish, I'm going to ask you some questions about it.

For example, if you read a story about a man painting a dog house and I asked you what the man was doing, you would say "painting the dog house."

Take as long as you need on each page, but when you turn a page, you cannot go back.

Here's the second story. It's about the Industrial Revolution and Cloth Production. Read it carefully because I'm going to ask you questions about it.

INSTRUCTIONS TO IMAGE

I want you to read some stories. To help you remember what the stories are about, on each page there will be the word "PICTURE" which will be a reminder to you to get a picture in your mind of the things that are happening in the story. I want you to try hard to do this because later I'll ask you to answer some questions and draw some of the pictures that you thought about.

For example, if you read a story about a man painting a dog house, you should get a picture of it in your mind. Tell me what your picture is like. Good. Here's an example of what your picture might have looked like. If I asked you a question about what the man was doing, you might recall the picture you thought about and said "painting the dog house."

Take as long as you need on each page but when you turn a page, you cannot go back.

Here's the first story; it's about Winnie-the-Pooh. Remember to read the story carefully and get a picture in your mind for each page. When you see the word "PICTURE" I want you to look up for a few seconds so that I know you're getting a picture in your head.

Here's the second story; it's about the Industrial Revolution and Cloth Production. Read it carefully and get a picture in your mind for each page.

INSTRUCTIONS TO SUMMARIZE

I want you to read some stories. To help you remember what the stories are about, on each page there will be the word "SENTENCE" which will be a reminder to you to think of what the story is about in your own words. I want you to try hard to do this because later I'll ask you to answer some questions and tell me some of the sentences that you thought about.

For example, if you read a story about a man painting a dog house, you should think of what the story is about in your own words. Tell me what you thought about. Good. Here's an example of what your sentence might have looked like. If I asked you a question about what the man was doing, you might recall the sentence you thought about and said "painting the dog house."

Take as long as you need on each page but when you turn a page, you cannot go back.

Here's the first story; it's about Winnie-the-Pooh. Remember to read the story carefully and think of what it's about in your own words for each page. When you see the word "SENTENCE" I want you to look up for a few seconds so that I know you're thinking about what the story is about.

Here's the second story; it's about the Industrial Revolution and Cloth Production. Read it carefully and think of what its about in your own words for each page.

EXPERIMENTER-PROVIDED ILLUSTRATION

I want you to read some stories. To help you remember what the stories are about, on each page there will be a picture that reminds you of some of the things that are in the story. I want you to look at these pictures carefully. Later I'll ask you to answer some questions about the story.

For example, if you read a story about a man painting a dog house, you would see this picture. If I asked you a question about what the man was doing, you might have recalled the picture and said "painting the dog house."

Take as long as you need on each page but when you turn a page, you cannot go back.

Here's the first story; it's about Winnie-the-Pooh. Remember to read the story carefully and look at the picture on each page.

Here's the second story; it's about the Industrial Revolution and Cloth Production. Read it carefully and look at the picture on each page.

EXPERIMENTER-PROVIDED SUMMARY

I want you to read some stories. To help you remember what the stories are about, on each page there will be a sentence that reminds you of some of the things that are in the story. I want you to look at these sentences carefully. Later I'll ask you to answer some questions about the story.

For example, if you read a story about a man painting a dog house, you would see this sentence. If I asked you a question about what the man was doing, you might have recalled the sentence and said "painting the dog house."

Take as long as you need on each page but when you turn a page, you cannot go back.

Here's the first story; it's about Winnie-the-Pooh. Remember to read the story carefully and look at the sentence on each page.

Here's the second story; it's about the Industrial Revolution and Cloth Production. Read it carefully and look at the sentence on each page.

REFERENCES

Anchor test study; equivalence and norms tables for selected reading achievement tests. Washington, D.C.: Government Printing Office, 1974.

Anderson, R. C., & Hidde, J. L. Imagery and sentence learning. Journal of Educational Psychology, 1971, 62, 526-530.

Anderson, R. C., & Kulhavy, R. W. Imagery and prose learning. Journal of Educational Psychology, 1972, 63, 242-243.

Andrasik, F., Liebert, D., & Koler, T. Imagery and the recognition of textual prose. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, 1974.

Ausubel, D. P. The Psychology of Meaningful Verbal Material, New York: Grove and Stratton, 1963.

Barclay, R. J. The role of comprehension in remembering sentences. Cognitive Psychology, 1973, 4, 229-254.

Bartlett, F. C. Remembering: A Study in Experimental and Social Psychology. Cambridge: University Press, 1932.

Begg, I., & Paivio, A. Concreteness and imagery in sentence meaning. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 821-827.

Bender, B. G., & Levin, J. R. Motor activity, anticipated motor activity, and young children's associative learning. Child Development, (in press).

Bower, G. H. Mental imagery and associative learning. In L. Greeg (Ed.), Cognition in Learning and Memory. New York: John Wiley & Sons, 1969.

Bransford, J. D., & Johnson, M. K. Semantic prerequisites for comprehending prose. Paper presented at Eastern Verbal Investigators League Meeting, 1971.

Bransford, J. D., & Johnson, M. K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of Verbal Learning and Verbal Behavior, 1972, 717-726.

Bruner, J. The course of cognitive growth. American Psychologist, 1964, 19, 1-15.

Bull, S. G. The role of questions in maintaining attention to textual material. Readings in Educational Research, 1973, 43, 83-88.

Cooper, C. The relationships among reading ability, grade level, and syntactical mediation in paired-associate learning. Paper presented at the annual meeting of the American Educational Research Association, Chicago, 1968.

Cromer, W. The difference model: A new explanation for some reading difficulties. Journal of Educational Psychology, 1970, 61, 471-483.

Curtis, M. E. The effects of mediation and passage structure on retention of prose. Unpublished master's thesis, University of Pittsburgh, 1975.

Danner, F. W., & Taylor, A. M. Integrated pictures and relational imagery training in children's learning. Journal of Experimental Child Psychology, 1973, 16, 47-54.

Davidson, R. E. Educational implications of research on elaboration, imagery, and memory: Discussion. Working Paper No. 62. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1970.

Davidson, R. E. Mediation and ability in PAL. Journal of Educational Psychology, 1964, 55, 352-356.

Davidson, R. E. The role of metaphor and analogy in learning. In J. R. Levin, & V. L. Allen (Eds.), Cognitive Learning in Children: Theories and Strategies. New York: Academic Press, (in press).

Davidson, R. E., & Adams, J. F. Verbal and imagery processes in children's paired-associate learning. Journal of Experimental Child Psychology, 1970, 9, 429-435.

Elkind, D. Developmental studies of figurative perception. In L. P. Lipsitt, & H. W. Reese (Eds.), Advances in Child Development and Behavior. New York: Academic Press, 1969.

Franks, J. J., & Bransford, J. D. The acquisition of abstract ideas. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 311-315.

Frase, L. T. Maintenance and control in the acquisition of knowledge from written materials. In R. O. Freedle, & J. B. Carroll (Eds.), Language Comprehension and the Acquisition of Knowledge. Washington D.C.: V. H. Winston & Sons, 1972.

Frase, L. T. Effects of question location, pacing, and mode of retention of prose material. Journal of Educational Psychology, 1968, 59, 244-249.

Frase, L. T. Boundary conditions for mathemagenic behaviors. Readings in Educational Research, 1970, 40, 337-348.

Gibbons, A. S., & Boutwell, R. C. The effects of instructions and provided illustrations on a memory task using prose materials. Paper presented at the California Educational Research Association, San Jose, 1972.

Guttmann, J. The effects of pictures and partial pictures on children's oral prose learning. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, 1976.

Heckler, J. H. A study of reading comprehension. Unpublished doctoral dissertation, University of Wisconsin, 1975.

Horowitz, L. M., Lampel, A. K., & Takanishi, R. N. The child's memory for utilized scenes. Journal of Experimental Child Psychology, 1969, 8, 375-388.

Johnson, M. K. Bransford, J. D., Nyberg, S., & Cleary, J. Comprehension factors in interpreting memory for abstract and concrete sentences. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 451-454.

Jones, H. R. The use of visual and verbal memory processes by three-year-old children. Journal of Experimental Child Psychology, 1973, 15, 340-351.

Kaplan, S. A. Elaboration and reading achievement as factors in children's learning of text materials. Technical Report No. 180. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1971.

Kerst, S., & Levin, J. R. A comparison of experimenter-provided and subject-generated strategies in children's paired-associate learning. Journal of Educational Psychology, 1973, 65, 300-303.

Kirk, R. E. Experimental Design: Procedures for the Behavioral Sciences. Belmont, Califronia: Brooks/Cole Publishing Co., 1968.

Kulhavy, R. W., & Swenson, I. Imagery instructions and the comprehension of text. British Journal of Educational Psychology, 1975, 45, 47-51.

Lesgold, A. M., Curtis, M. E., DeGood, H. Golenkoff, R. M., McCormick, C. & Shimron, J. The role of mental imagery in text comprehension: Preliminary studies. Pittsburgh, Pennsylvania: University of Pittsburgh, Learning Research and Development Center, 1975.

Lesgold, A. M., & Curtis, M. E. Instructional effects on memory structure for prose. Paper presented at the annual meeting of the Psychonomic Society, Boston, 1974.

Lesgold, A. M., & DeGood, H. Prefamiliarization and reading comprehension. Paper presented at the annual meeting of the American Educational Research Associating, Chicago, 1973.

Lesgold, A. M., Levin, J. R., Shimron, J., & Guttmann, J. Pictures and young children's learning from oral prose. Journal of Educational Psychology, 1975, 67, 636-642.

Lesgold, A. M., McCormick, C., & Golinkoff, R. M. Imagery training and children's prose learning. Journal of Educational Psychology, 1975, 67, 663-667.

Levin, J. R. Comprehending what we read: An outsider looks in. Journal of Reading Behavior, 1972, 4, 18-20. (a)

Levin, J. R. When is a picture worth a thousand words. In Issues in Imagery and Learning: Four Papers. Theoretical Paper No. 36. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1972. (b)

Levin, J. R. Inducing comprehension in poor readers: A test of a recent model. Journal of Educational Psychology, 1973, 65, 19-24.

Levin, J. R. Determining sample size for planned and post-hoc analysis of variance comparisons. Journal of Educational Measurement, 1975, 12, 99-108.

Levin, J. R. What have we learned about maximizing what children learn? In J. R. Levin, & V. L. Allen (Eds.), Cognitive learning in children: Theories and strategies. New York: Academic Press, (in press).

Levin, J. R., Bender, B. G., & Lesgold, A. M. Pictures, repetition, and young children's oral prose learning. Working Paper No. 162. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1976.

Levin, J. R., Davidson, R. E., Wolff, P., & Citron, M. A comparison of induced imagery and sentence strategies in children's paired-associate learning. Journal of Educational Psychology, 1973, 64, 306-309.

Levin, J. R., & Divine-Hawkins, P. Visual imagery as a prose learning process. Journal of Reading Behavior, 1974, 6, 23-30.

Levin, J. R., Divine-Hawkins, P., Kerst, S., & Guttmann, J. Individual differences in learning from pictures and words: The development and application of an instrument. Journal of Educational Psychology, 1974, 66, 296-303.

Levin, J. R., Ghatala, E. S., Guttmann, J., Subkoviak, M. J., McCabe, A. E., & Bender, B. G. Processes affecting children's learning from sentences. Technical Report (in press). Madison: Wisconsin Research and Development Center for Cognitive Learning.

Levin, J. R., Horvitz, J. M., & Kaplan, S. A. Verbal facilitation of paired-associate learning: A limited generalization? Journal of Educational Psychology, 1971, 62, 439-444.

Mallory, W. A. Abilities and developmental changes in elaborative strategies in paired-associate learning of young children. Journal of Educational Psychology, 1972, 63, 202-217.

Milgram, N. A. Verbal context versus visual compound in paired-associate learning by children. Journal of Experimental Child Psychology, 1967, 5, 597-603.

Milne, A. A. Winnie-The-Pooh. Dutton, 1926.

Odom, P. B., & Nesbitt, N. H. Some processes in children's comprehension of linguistically and visually depicted relationships. Journal of Experimental Child Psychology, 1974, 17, 399-408.

Paivio, A. On the functional significance of imagery. Psychological Bulletin, 1970, 73, 385-392.

Paivio, A. Imagery and Verbal Processes. New York: Holt, 1971.

Peeck, J. Retention of pictorial and verbal content of a text with illustrations. Journal of Educational Psychology, 1974, 66, 880-888.

Pressley, M. Mental Images help eight year olds remember what they read. Journal of Educational Psychology, (in press).

Rasco, R. W., Tennyson, R. D., & Boutwell, R. C. Imagery instructions and drawings in learning prose. Journal of Educational Psychology, 1975, 67, 188-193.

Reese, H. W. Imagery in paired-associate learning in children. Journal of Experimental Child Psychology, 1965, 2, 290-296.

Reese, H. W. Cohert, age, and imagery in children's paired-associate learning. Child Development, 1974, 45, 1176-1178.

Rohwer, W. D., Jr. Constraint, syntax, and meaning in paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 541-547.

Rohwer, W. D., Jr. Mental elaboration and proficient learning. Minnesota Symposia on Child Psychology, Vol. 4, 1970.

Rohwer, W. D. On attaining the goals of early childhood education. Harvard Educational Review, 1971, 41, 316-341.

Rohwer, W. D., Jr. Elaboration and learning in childhood and adolescence. In H. W. Reese (Ed.), Advances in Child Development and Behavior. New York: Academic Press, 1973.

Rohwer, W. D., Jr., Ammon, M. S., Suzuki, N., & Levin, J. R. Population differences in learning proficiency. Journal of Educational Psychology, 1971, 62, 1-14.

Rohwer, W. D., & Bean, J. P. Sentence effects and noun-pair learning: A developmental interaction during adolescence. Journal of Experimental Child Psychology, 1973, 15, 521-533.

Rohwer, W. D., & Harris, W. J. Prose learning in children as a function of presentation mode, test condition, and population. Journal of Educational Psychology, 1975, 67, 651-657.

Rohwer, W. D., Lynch, S., Suzuki, N., & Levin, J. R. Verbal and pictorial facilitation of paired-associate learning. Journal of Experimental Child Psychology, 1967, 5, 294-302.

Rohwer, W. D., Jr., Lynch, S., Levin, J. R., & Suzuki, N. Pictorial and verbal factors in the efficient learning of paired-associates. Journal of Educational Psychology, 1968, 58, 278-284.

Rohwer, W. D., & Matz, R. D. Improving oral comprehension in white and black children, pictures vs. print. Journal of Experimental Child Psychology, 1975, 19, 23-36.

Romberg, T. A., & Wilson, J. W. The effects of an advance organizer, cognitive set, and post organizer on the learning and retention of written materials. Journal for Research in Mathematics Education, 1973, 4, 68-75.

Rothkopf, E. Z. The concept of mathemagenic activities. Review of Educational Research, 1970, 40, 325-336.

Rothkopf, E. Z. Structural text features and the control of processes in learning from written material. In R. O. Freedle, & J. B. Carroll (Eds.), Language Comprehension and the Acquisition of Knowledge, Washington, D.C.: V. H. Winston & Sons, 1972.

Rothkopf, E. Z., & Bisbicos, E. Selective facilitative effects of interspersed questions on learning from written material. Journal of Educational Psychology, 1967, 58, 56-61.

Samuels, S. J. Effects of pictures on learning to read, comprehension, and attitudes. Review of Educational Research, 1970, 40, 397-407.

Semler, I. J., & Iscoe, I. Comparative and developmental study of the learning abilities of negro and white children under four conditions. Journal of Educational Psychology, 1963, 54, 38-44.

Shimron, J. Imagery and the comprehension of prose by elementary school children. Unpublished doctoral dissertation, University of Pittsburgh, 1974.

Snowman, J., & Cunningham, D. J. A comparison of pictorial and written adjunct aids in learning from text. Journal of Educational Psychology, 1975, 67, 307-312.

Social Science - Concepts and Inquiry Series: The Challenge of Change. Boston: Allyn & Bacon, 1970.

Stevenson, H. W., Friedrichs, A. G., & Simpson, W. E. Interrelations and correlates over time in children's learning. Child Development, 1970, 41, 625-637.

Varley, W. H., Levin, J. R., Severson, R. A., & Wolff, P. Training imagery production in young children through motor involvement. Journal of Educational Psychology, 1974, 66, 262-266.

Vernon, M. D. The value of pictorial illustration. British Journal of Educational Psychology, 1953, 23, 180-187.

Vernon, M. D. The instruction of children by pictorial illustration, British Journal of Educational Psychology, 1954, 24, 171-179.

Wiener, M., & Cromer, W. Reading and reading difficulty: A conceptual analysis. Harvard Educational Review, 1967, 37, No. 4.

The Wisconsin Design for Reading Skill Development. Minneapolis: National Computer Systems, 1974.

Yuille, J. C., & Catchpole, M. S. Associative learning and imagery training in children. Journal of Experimental Child Psychology, 1973, 16, 403-412.